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THE SEATTLE REGRADE, WITH PARTICULAR REFERENCE TO THE JACKSON ST. SECTION.

By LOUIS P. ZIMMERMAN.*

Seattle, Wash., is confronted with an immense problem that is and must be solved in order that the city may continue to flourish and grow. This problem consists briefly in regrading and leveling the hilly streets and adjacent property on which the city is built.

Commercially, Seattle has every advantage. Here terminate the transcontinental railway systems of the Pacific Northwest; here are the terminal wharves of the steamship lines running to Alaska, the Asiatic ports, the west coast of South America, the Pacific Islands and Canada; and here is found cheap and convenient transportation between the many growing towns on the numerous islands and natural harbors of the Puget Sound country.

Seattle fronts on Elliott Bay, a branch of Puget Sound, which forms an extensive deep-water harbor protected from storms, and accessible to the largest vessels afloat, at all times and at all stages of tide. On the east side is Lake Washington, a body of fresh water twenty-five miles long, from two to four miles wide and of great depth. Lake Union and Green Lake, smaller fresh water bodies, lie wholly within the city limits. The surface of the city is hilly, consisting principally of long ridges, which rise to an elevation of about 300 ft. above the level of the sound, with a few higher buttes.

These long, hilly ridges present a problem to Seattle, the magnitude of which has seldom or never been equaled in any city of the world. To accommodate the great, growing business districts of the city, new ground areas must be produced, with a maximum grade so low that the retail traffic can be moved by teams without exhaustive effort. To get these areas Seattle is carrying out the most extensive regrade of any city in the country. Whole sections are being cut down from 10 to 100 ft., and new blocks are being built up on the hitherto worthless tide flats.

Steam shovels, cars and wagons were so inadequate for this project that, except in special cases, they were not considered. Water, both fresh and salt, is unlimited here in quantity. Hydraulic sluicing was adopted to level Seattle's hills and convert almost worthless buttes into valuable property. Two methods of disposing of the vast amount of earth presented themselves. One, was to waste it into the sound; the other, to sluice it onto the tide flats.

The regrade work in Seattle may be divided into three large and three small areas. The ultimate aim is to level the entire business and abutting sections. This is being done by parts, the more urgent needs being taken first. The Jackson St. regrade, extending from Washington St. to Addition St., and from 4th Ave. to 12th Ave., south, adjoining the Union depot, is one of the three great centers of attack at present. This area includes 120 acres of property and 5.8 miles of street and entails the removal of 3,400,000 cu. yds. of earth. The project involves the leveling of the Jackson St. hill, which lies just back of the business district of the city, and depositing the excavated material on the tide flats adjacent on the south. Fig. 1 shows the old and new grades of Jackson St. Fig. 2 and the view on this page show the sluicing work in progress, and Fig. 3 shows the method employed in building up a 1½ to 1 slope with material deposited by the hydraulic process. Work upon this section is now being carried on with six 4-in. giant nozzles, using 12,000,000 gals. of fresh and 12,000,000 gals. of salt water every 24 hours. The cost of the work on this regrade will be $515,000, exclusive of the cost of grading private property. The work is divided as follows:

	Excavating.	Embankment.
Total streets	1,791,115	1,388,994
Total alleys	35,631	65,830
Total blocks, private	1,515,279	973,110
Street railway	82,238	35,865
Total	3,424,263	2,465,799

Lewis & Wiley are the contractors on this regrade. They are allowed 15% for embankment shrinkage. Other terms of the contract are as follows:

CONTRACTORS TO PAY CITY:

For water from the city reservoir, $20 per million gals.
Use of Lake Washington pumping plant, $3,000 per year.

CONTRACTORS ARE TO RECEIVE:

Clearing and grubbing	$30,000
Earth excavating, 1,770,000 cu. yds., at 10 cts.	177,000
Earth embankment, 1,363,000 cu. yds., at 15 cts.	204,450
New lumber, 100 M. ft., at $24	2,400
Relaying old lumber	750
Concrete retaining walls, 600 cu. yds., at $10	6,000
Iron railing	500
Bulkhead piling, 5,000 ft., at 40 cts.	20,000
Bulkhead lumber	12,500
Iron, 200,000 lbs., at 5 cts.	10,000
Oak blocks	375
Sewer box	7,500
Total	$471,475

According to the charter of Seattle, improvements amounting to more than 50% of the assessed value of the property benefited cannot be made without a petition therefor, signed by 75% of the property holders affected. Fifty per cent. of the assessed value of this property is

NEW GRADE OF WELLER STREET, JACKSON STREET REGRADE WORK, SEATTLE, WASH.

(Weller St. is parallel with Jackson St. The view is taken from Twelfth Ave., South, and Weller St., looking N. W. towards the business district. Grade of Weller St. reduced from 13% to 5%.)

*302 Pioneer Building, Seattle, Wash.

$515,813, so that the above contract is well within the limit.

The contractors remove the ground from private property at 10 cts. per cu. yd. and render each owner a statement of his amount. The property owners have the right to pay cash, or in five or ten-year installments at 7% interest. It may seem a hardship to assess a poor man so extensively, but the assessments are small in comparison with the increased value of the property. Even if forced to sell, owners can often get from three to six times as much as the property was worth before the regrade.

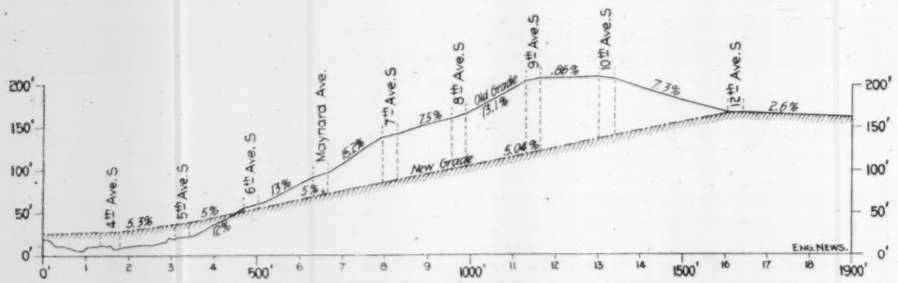

FIG. 1. PROFILE OF JACKSON STREET REGRADE ON LINE OF JACKSON STREET, SEATTLE, WASH.

Work on the Jackson St. contract began in May, 1907, and the contract calls for its completion in thirty months. The progress made thus far indicates that the work will be completed on time. Hydraulic sluicing is used entirely except for leveling and surfacing. Water is supplied from two sources, fresh water from the city reservoir on Beacon Hill and salt water from a pumping plant on Elliott Bay, at the foot of Connecticut St., over 6,000 ft. from the center of the work.

The salt water pumping plant was designed and built under the personal supervision of McAllaster & Bennett, consulting engineers, of Seattle. Tides were the first problem presented in the erection of a pump house. The extreme high tides of winter are some 20 ft. above the low tides of summer. The pump house, a 31 × 37-ft. wooden building, is built on piles about 200 ft. from the shore. The floor, which was made water-tight to protect motors in case of extreme high tide, is composed of 1½-in matched flooring, covered with 3 × 6-in. plank. It was necessary to place the pumps as low as possible to be able to operate them without too great a suction head at low tide. The pump-house floor was placed at normal high tide level. The sides of the house are made water tight for a distance of 2½ ft. above the floor by using 2 × 4-in. timbers and calking the joints. Inside, a bulkhead encloses a space 13 × 23 ft. in plan, occupied by the pumps and motors. The remaining floor space may be flooded at high tide to prevent the building from floating away.

There are two pairs of 19-in. five-stage Worthington turbine pumps, each pair direct-connected by a flexible shaft to a 650-HP., 2,000-volt, two-phase, A. C. synchronous Westinghouse induction motor. Each unit is capable of supplying 6,000,000 gals. of water per 24 hrs. against a head of 380 ft. The pumps operate normally at 690 r. p. m., having thrust bearings with six collars and oil-enclosed cooling rings surrounded by circulating water. The vanes of the pump are bronze to resist the action of the salt water. A pressure of about 155 lbs. is maintained.

Power is obtained from Snoqualmie Falls at 27,000 volts and stepped down to 2,000 volts by transformers at the pump house. To avoid the heavy starting current of the large induction motors, which is four to five times the normal operating current, a series of ten solenoid starting switches and a master switch are used.

The pumps discharge into a 24-in. fir wood pipe, which is equipped with a stand-pipe that acts as a surge tank to prevent damage due to turning off the nozzles on the work. The pipe was built by the Pacific Coast Pipe Co., of Ballard, Wash., and is designed to stand 375 ft. head. The pipe is laid in lengths of 8 to 16 ft. and is joined with wooden collars and covered with No. 1 galvanized iron wire, 9/16-in. c. to c. The pipe is protected externally with several coats of heavy tar paint. On Saturday nights, when work is shut down, the salt water is flushed out and the pipes are filled with fresh water to prevent the teredoes from boring into the pipe.

Considerable difficulty was found in laying the pipe. As laid, it passes under two heavy traffic streets, two street car tracks and several railroad tracks. For a considerable distance over the tide flats it is supported on blocks or suspended from the bridges. Although salt water is obtainable in any quantity and is more effective than fresh water, due to its greater specific gravity, there is the objection of the water foaming and air bubbles being carried in, thus reducing the effective area of the pipe. Four branches lead from this line to four giant cast-iron nozzles, varying in effective diameter from 2.5 to 4 ins. Each giant is mounted on a reducer and a ball and socket joint, so that a sweep of a full circle can be obtained. The nozzles are fitted with handles at the nozzle end, and with a board and box counterweight by means of which adjustment can be made in any direction and at almost any angle.

The operators of these nozzles have all seen service sluicing in Alaska. The streams are directed only toward the bottom strata and worked to within a foot of the final grade (see Fig. 2 and view on p. 509). This leaves little surfacing to be done by hand. The soil in being undermined works well together, lubricating itself fairly well under the guidance of a skillful operator. About 60% is blue clay. The yellow clay, loam and sand wash away fairly easily, but the lower strata of hardpan or blue clay requires blasting. In shooting, the clay carries the concussions along the strata and people living on the other side of the hill complain, while those directly above are not affected. Gravel is the hardest to handle. The fine sand washes out and leaves the heavier gravel. The sand occasional boulders are disposed of with the boulders and contractors who haul them away with wagons.

In disposing of the earth the contractor starts at the point of disposal on the tide flats and determines how high the fill is to be at that point. Then knowing that sluiced material will spread with a slope of about one to five, he calculates how high above the grade level he must ultimately have the outfall line. As a grade of 4% is necessary for open sluice and only 2% for pipe, he determines which to use, that he may have grade enough to carry the material where he wants it. For open sluice boxes, only guide boards are used to convey the material into them. For pipes, temporary wooden penstocks are built ahead of the pipe. The pipes used are 24-in. fir pipe. As the sluicing water carries approximately 20% of material in suspension, the wearing action on the pipe is very great. To prevent this a patented filler is used in the pipe, with a cross section as shown in Fig. 4. Two of the staves are specials and between them fit the fillers, which are laid on the bottom side of the pipe. These fillers are cut so that their grain is at right angles to the line of flow. Such a filler will last about six months and can then be replaced, thus saving the costly pipe.

The contractors have a small electrically-driven saw mill and blacksmith shop, in which they do small repair work.

With the disposal of this immense amount of material and the work on the tide flats, several problems of exceptional engineering interest are encountered. This district is covered with places of business, access to which must be provided by temporary bridges, built on piles and moved as required. New streets are constantly being laid out in the filled tide lands.

In filling a block, the sluiced materials are led on to the tide flats and there allowed to spread. Dikes are built at the lower ends of the filled districts, which check the velocity of the water and allow the earth to precipitate. The water passing through the spillways, over the dikes, has carried with it enough fine material in suspension to raise the level of the lower tide flats about 2 ft.

The problem of sanitation and sewage disposal is important because the district is thickly settled. The people living in the district regraded have the choice of tearing down their houses or moving them off, either of which entails crowded and unnatural conditions. On

FIG. 2. FOUR 4-IN. GIANT NOZZLES PLAYING ON REGRADE WORK, SEATTLE, WASH.
(Looking N. W. on Weller St., between Ninth and Tenth Aves., South, where there is a 75-ft. cut. The old grade line of Jackson St. may be seen at the crest of the cut on the right.)

the adjoining streets and lots houses are crowded together and temporary sewage disposal by means is necessary. This is well effected by means of 1 × 1-ft. box sewers, 3 ft. underground, leading to the tide flats. These wooden boxes are buried beneath the fill and permanent brick sewers will be installed after the work has been finished. The temporary sewers are suspended under the traffic bridges or placed on piles, and have uprights so that a higher level connection can be made into them, after the filling is completed, and before the permanent sewers are finished. The temporary sewers are put in by the contractors at 75 cts. per lin. ft.

FIG. 3. BUILDING A 1½ TO 1 SLOPE BY HYDRAULIC FILL ON JACKSON STREET REGRADE, SEATTLE, WASH.
(At Southeast Corner of Sixth Avenue, S and Weller Street.)

One very striking and beneficial effect has been the cleaning up of the district in which the work is going on. Before, the buildings were all on the low, wet grounds adjoining the tide flats. At high tide they were soaked, and the result was a dirty, filthy region that naturally became the immoral center of Seattle. Since the regrade began, these buildings have been raised from 20 to 40 ft., are now on piles and have plenty of dry air around them. House moving has developed into an important business. The cost is often excessive, in some cases more than the building is worth. A three-story frame building, 60 × 120 ft. in plan, can be raised 40 ft. and blocked for about $2,000.

Fig. 4. Cross-section of Mud Line Pipe Used on Jackson Street Regrade, Showing Filler for Reducing Wear.

The new grades, for east bound traffic on Jackson St., are shown on the profile (Fig. 1) to be about 5%, as compared to from 5 to 13% at present. On Weller St., which has just been opened for traffic, the grades are 7% to north bound traffic. The grades on north and south streets are: on Fourth Ave., 0.4 to 2.9%; on Sixth Ave., 0.7 to 1%; and on Eighth Ave., 5% to west bound traffic.

As a summary of the great work it is well to note the proportions of the other districts. The district north of the central part of the city, known as the Third Ave. regrade, includes 95 acres, 2.6 miles of street and 5,400,000 cu. yds. of earth. On this section four nozzles are using 14,000,000 gals. of water every 24 hours, and two steam shovels, six locomotives and 36 dump cars are also employed. The cost of this regrade will be about $1,000,000, exclusive of cost of grading private property.

The third great section is the Fourth Ave. regrade of 40 acres, 1.7 miles of street and 540,000 cu. yds of earth. Two steam shovels, four locomotives and 35 dump cars are in use here.

The material from Jackson and Fourth Ave. districts is being used to fill tide lands. That of the Third Ave. district cannot be conveniently brought to the tide lands and it is wasted into the sound.

The three smaller sections of regrade work comprise 126 acres, 5.4 miles of street and involve 700,000 cu. yds. Here are needed one steam shovel, two locomotives and 20 cars.

This gives a grand summary of 15.4 miles of streets, 271 acres of area and 10,000,000 cu. yds of earth to be moved at a cost of $2,018,000, exclusive of charges against private property. Besides this there are five other districts which will be completed in the coming three years, to include 237 acres, 14 miles of street and 6,000,000 cu. yds., at a cost to the city of $1,300,000. In all, this involves one-eighth as much dirt as is being moved in the great canal project at Panama.

This gigantic work so carefully laid out and so faithfully being carried out by R. H. Thomson, M. Am. Soc. C. E., who has been city engineer for sixteen years, will lay the foundations to make Seattle one of the greatest cities in the United States.

SHORT AND ODD LENGTHS OF LUMBER is the subject of a brief bulletin sent out by the U. S. Forest Service. It is stated that 25% of the felled trees are never hauled from the woods simply because specifications of builders and architects cling to conventional lengths, whereas the actual construction is such as to easily use the short and odd lengths. The work of a prominent architect was examined and it was found that 40% of the siding on frame buildings was under 6 ft. in length. It was found that in cutting and grading finished lumber generally, that 5 to 10% was bound to come in lengths under 10 ft., of which all under 6 ft. is burned and all over is sold at reduced prices. This bulletin asks for closer specifications, better understanding of the timber situation as a help to the lumbermen and for the preservation of the lumber supply.

PRINTING ON TRACING CLOTH WITHOUT A PRESS.

By FRANK T. DANIELS.*

When many drawings, as in a contract set, are to have the same title, the saving of time effected by using printers' type is very great, even though some parts, as the date and scale, may be filled in by hand. The saving in cost is even greater than that in time, since the printing can be done by one who does not command the salary of a skilled draftsman. The articles needed for this work are simple and cheap, with the exception of the press, which, if used, needs to be of special construction to allow printing to be done on a small area in any part of a drawing, the remainder of the sheet being rolled up out of the way. The difficulty and expense of getting a press adapted to this work has led to the construction of some wooden, home-made presses upon which very good work has been done.

But it has been found that good results may be obtained without the use of a press. The process is as follows:

Fasten a piece of ⅞-in. board about 2 ft. long to a table or other convenient flat surface. Set up the type in the usual manner, and fasten it, face up, adjacent to the board, whose surface will be flush with the face of the type. Place the tracing, face down, upon the type in the proper position to receive the imprint, with the sheet overlapping the board. Having fastened the sheet to the board with thumb tacks or weights, fold back the part that is to be printed, and ink the type; then carefully replace in its former position the part just folded back and, with a smooth, hard instrument, such as the handle of a tooth brush, rub the sheet lightly and carefully down upon the type, treating a line at a time if the type is large. The translucence of the cloth allows the operator to see when perfect contact between cloth and type has been secured.

Of course it is necessary that the cloth shall not shift upon the type. If the area to be printed is small the slack of the sheet may be held with one hand while the rubbing is done with the other; if the area is large a second board may be placed opposite the first one, and to this second board the part of the sheet overlapping the type may be secured before the rubbing is commenced.

Whether or not a press is used, the following precautions should be observed:

(1) The very best ink must be used, such as the "Keloe," which is sold in collapsible tubes. A small quantity is placed upon a piece of plate glass, and rolled out thin and smooth with a small printers' roller, with which it is then applied to the type. The exact quantity of ink to be put upon the type must be found by experience, but it is always very small.

(2) The roller need not be more than 2 or 3 ins. long, but it must be soft. Sometimes a better result is obtained by applying the ink by "patting," rather than by rolling.

(3) Immediately after removing the sheet from the type the lettering should be sprinkled with talcum powder to prevent "set-off," or blurring. The surplus powder may be lightly brushed off at once, but a day or two should elapse before the drawing is handled freely.†

(4) When printing is finished for the time being, roller, glass and type should be thoroughly cleaned with benzine applied with a brush or soft cloth. The pressure of a cloth in rubbing the types should be very slight, otherwise their edges are soon rounded.

If many drawings are to receive the same title it is sometimes more satisfactory to make a design of the title in the ordinary way, rather than to use type. A zinc "relief-plate" may then be obtained from the design, at small cost, and used as described above for type. A title printed from such a plate can hardly be distinguished from one drawn with India ink, and it blueprints perfectly.

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*31 Milk St., Boston, Mass.

†Notes on methods and time required for drying printers' ink on tracing cloth were published in Eng. News, Vol. XXXVIII., pp. 42 and 57.—Ed.

THE MOVABLE DAMS AND LOCK AT THE POWER PLANT ON THE CHICAGO DRAINAGE CANAL.

The water-power extension of the Chicago Drainage Canal has some interesting equipment to provide for regulating and controlling the flow of water, and for enabling canal boats to pass the dam. This equipment includes the following: (1) a vertically pivoted butterfly dam; (2) two horizontally pivoted movable-crest dams; (3) a canal boat lock and gates. Provision has been made, also, for a future large ship-lock forming a link in the proposed waterway from Lake Michigan to the Mississippi River.

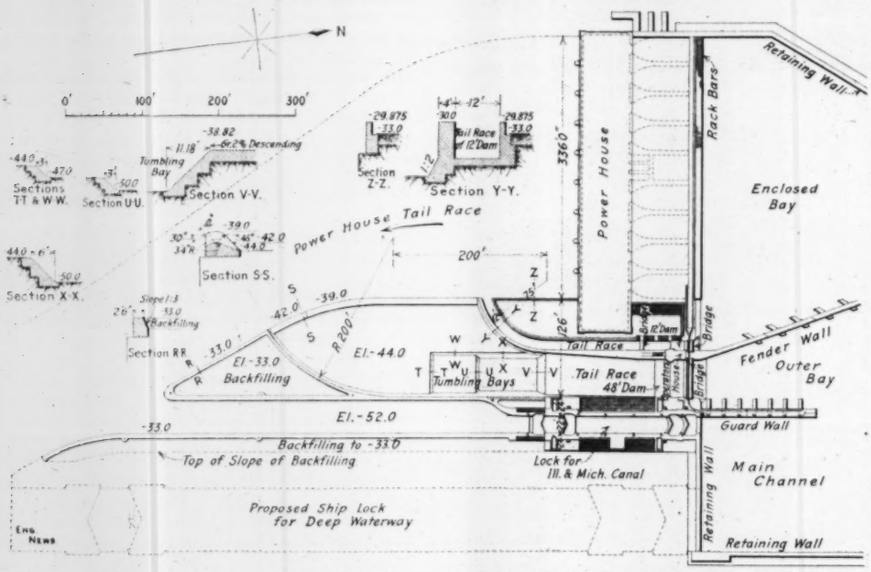


FIG. 1. PLAN SHOWING LOCKS AND DAMS FOR CONTROLLING WATER FLOW AND PASSING NAVIGATION AT THE LOCKPORT POWER PLANT OF THE CHICAGO DRAINAGE PLANT.

The power plant, with its canal, machinery, etc., was described and illustrated in Engineering News of Jan. 12, 1905, and Jan. 18, 1906. The work was done under the direction of Mr. Isham Randolph, M. Am. Soc. C. E., as Chief Engineer. Mr. G. M. Wisner, M. Am. Soc. C. E., is now Chief Engineer, Mr. Randolph being Consulting Engineer. The Hayes Brothers Co., of Janesville, Wis., had the general contract for the entire work.

The drainage canal, as originally built, terminated in a wide basin at Lockport. Along one side of this basin were placed the bear-trap dam and modified Stoney sluice gates for controlling the flow from the canal into the tail race leading to the Des Plaines River. The end of the basin was formed by a concrete wall and an embankment or dam. The power canal or head race is an extension of the main canal, opening by a cut through this embankment. It is 160 ft. wide and nearly two miles long, terminating in a large basin or forebay which is closed by the dam of the power plant. This basin provides a steady supply to the turbines, free from fluctuations due to the draft caused by the passage of boats through the lock.

The dam is about 600 ft. long, of which 386 ft. are occupied by the power-house. This will have eight generating units, each of 4,000 KW. capacity. Five of these are now in place. In the remaining portion of the dam are the openings for the canal lock and the two movable-crest dams. A plan of this part of the work is shown by Fig. 1. A cross wall or fender wall pierced with submerged arches extends diagonally across the forebay, and is designed to exclude floating ice and drift from the intakes of the water wheels. A guard wall of similar construction also extends above the lock, in order to prevent canal boats from being drawn against the adjacent movable dam by the current. Fig. 2 is a view taken on the down-stream side. At the left is the power-house, with an approach track supported by concrete piers in the wide part of the tail race. Adjacent to the power-house are the two movable dams. The tail race of the smaller dam curves around the corner of the power-house. The tail race of the large dam opens into the fan-shaped space in the foreground. To the right of the dams is the canal lock

BUTTERFLY DAM.—The entire flow of the drainage canal will pass normally through the power canal, and thence through the turbines and over the dams into the tail race. There is a fall of 34 ft. at the power-house dam. Although no controlling works have been built at the upper end of the drainage canal, it was considered advisable to install such works at the head of the power canal. In the event of any accident at the power-plant, therefore, the flow in the power canal or head race can be shut off. The water in the drainage canal will then discharge (as formerly) by the bear-trap dam and sluice gates mentioned above.

In view of the fact that this part of the canal carries the boats navigating the Illinois & Michigan Canal (and will form a part of the future waterway from Lake Michigan to the Mississippi River), it was necessary that the headworks should form no obstruction to navigation. The plan adopted was devised by Mr. Isham Randolph, M. Am. Soc. C. E., while Chief Engineer. The details of the design were worked out by Mr. C. R. Dart, M. Am. Soc. C. E., Bridge Engineer of the Chicago Sanitary District, assisted by Mr. S. T. Smetters, Assistant Bridge Engineer. It consists essentially in the use of a movable gate or dam carried by vertical pivots and arranged to swing across the channel.

The dam resembles a huge steel lock gate, but revolves on pivots at its center. The gate stands normally open and in the center line of the canal. Its ends are protected by concrete guard piers, and these are connected by a steel truss bridge (parallel with the canal) which carries the upper pivot. The dam pier thus receives the pressure from the top pivot of the dam. On each side of the pier is a channel 80 ft. wide in the clear. The gate is operated by electric power, assisted by unbalanced hydraulic pressure against the halves It has in each half of the gate six openings 4 × 6 ft., fitted with electrically-operated sluice valves. Some or all of these in the leaf which moves down-stream may be closed when the gate swings, so that this half receives the full water pressure. In the half which moves up-stream, however, the sluices are opened and give a large total area of opening for the passage of water through this part of the gate. When closed, an automatic lock transmits the pressure on the gate to the masonry walls. In opening the dam, the sluice valves are opened in the leaf which will swing up-stream, and when the locks are released the unbalanced pressure against the other leaf will swing the dam with very little assistance from the operating machinery.

When the dam is closed, the pressures due to the head of water is about 1,900 tons at the bottom pivot and 725 tons on the top pivot. These are the pressures which would result from failure of the end latch to engage and transfer a portion of the pressure to the side walls of the channel. The leaf was calculated for this condition, using a higher unit stress in the metal, so that no damage could result therefrom. With the end latch engaged, the leaf will act as a continuous girder instead of a cantilever. The dam is figured for a 30-ft. head of water; that is, with the water up to its crest.

The dam is 184½ ft. long and 30 ft. high, with a weight of about 700 tons. It was built by the Strobel Steel Construction Co., of Chicago.

MOVABLE-CREST SECTOR DAMS. The dam which forms the end of the basin of the power-house has (as noted above) two movable-crest dams for regulating and controlling the flow of water. Their location is shown in Fig. 1. They are of the horizontally pivoted type, and fulfill two functions: (1) to regulate the flow in the canal when the power-plant is using only a part of the flow; (2) to carry off ice or floating debris that may collect in the forebay.

One of these dams is 12 ft. long. This is placed adjacent to the end of the power-house. It serves to discharge the material raked from the screen racks at the intakes of the wheel pits, and also such submerged floating material as may find its way into the enclosed part of the forebay. The other dam is 48 ft. long. It serves to regulate the water level in the forebay and the flow in the canal. The vertical range of movement of the crest is 18 ft.; from 2 ft. above to 16 ft. below Chicago city datum. The elevation of water level in the forebay or basin will be usually about 6 ft. below Chicago datum. The discharge of large volumes of water over the 48-ft. dam would be liable to cause washing or erosion of the main race, and also objectionable currents and eddies. To prevent such action, the tail race of this dam is so shaped as to form a tumbling bay in which the force and velocity

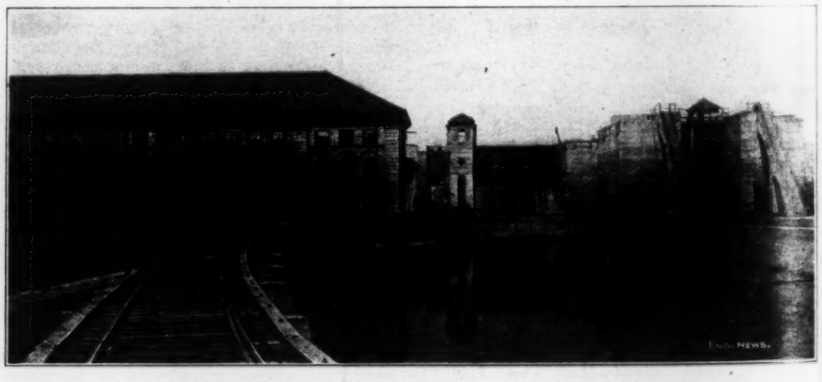
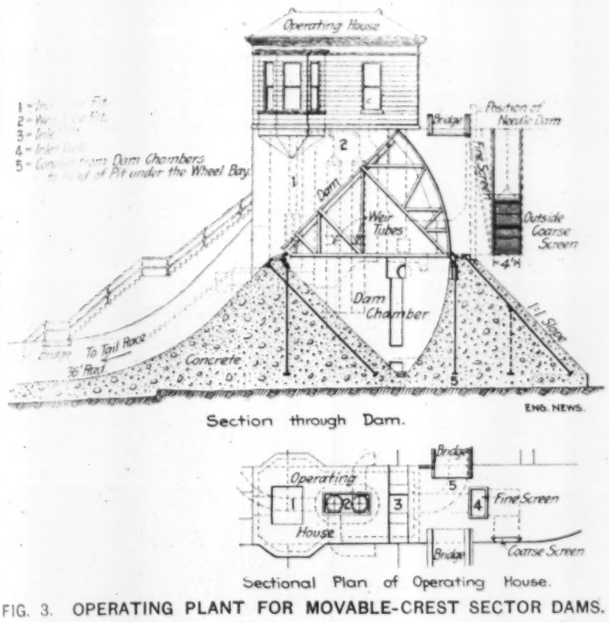


FIG. 2. LOCK AND MOVABLE DAMS AT THE LOCKPORT POWER PLANT.

of the flowing water will be absorbed. The bay is deeper than the race, so as to contain a body of practically inert water. The flow from this is distributed over the flaring or fan-shaped end of the tail race. At the end of this is a low weir over which the water flows into the main tail race below the power-house. This arrangement is shown by the plan and sections in Fig. 1. All the masonry work is of reinforced concrete, and the concrete floor of the race-way of the 48-ft. dam is anchored to the rock by numerous anchor bolts.



Section through Dam.

Sectional Plan of Operating House.

FIG. 3. OPERATING PLANT FOR MOVABLE-CREST SECTOR DAMS.

The two dams are identical in design and construction, except in regard to their length. The arrangement and general design are shown in Fig. 3, while the structural details are shown in Fig. 4. A view of the dam under construction is shown in Fig. 5. The dam is a 45° sector of a horizontal cylinder 52 ft. in diameter. The curved face is of steel plates carried by radial frames bearing against a horizontal pivot or hinge. The upper line of radial arms carries a steel plate deck, upon which are riveted steel angles to serve as ice skids. This deck is horizontal when the dam is lowered to its lowest position, and stands at an angle of 45° when the dam is raised to its highest position. The dam is pivoted on the down-stream side, which is the reverse direction from that which has been employed in earlier forms of sector dams. The design and details were made by Mr. E. L. Cooley, Assistant Engineer of the Sanitary District. The steel structures were built by the Chicago Bridge & Iron Co., of Chicago.

The face of the dam moves behind a concrete breast wall, which is curved to fit the contour of the face. Its hinge bearing is carried by a concrete back wall. The hinge or pivot consists of lengths of 4-in. shafting carried in cast steel brackets or pedestals on the back wall, and engaging with segmental bearings attached to the heel of the movable dam. The hinge joint is made watertight, and steam pipes are fitted to prevent water freezing at the joint and beneath the dam. When the dam is lowered, a steel bar riveted along the lower edge of the face rests upon an oak timber, having the grain crosswise of the timber to prevent splitting. The ends of the timber are steel angles, and it is bolted to a pine sill. On the top of the breast wall is a cast-iron wall plate with stops to limit the upward travel of the dam, so that the lower edge of the sector or face cannot rise above the wall. The dam can be held in its raised position by cast steel props or dogs keyed upon a shaft carried by brackets set in the face of the breast wall. The 12-ft. dam has one prop in the middle. The other has four props 12 ft. apart. The arrangement of these props is shown by detail A in Fig. 4. The chamber under the dam can be emptied by means of a culvert with valves. With the dam thus supported, and the water drawn off from beneath it, the dam and chamber are readily accessible for inspection, repairs or cleaning.

The dam moves in a closed chamber formed by the breast wall, the back wall and two end walls. The clearance at the face is only about 1/16-in. Along the edge of the cast-iron breast-plate is a heavy flat bar or plate and upon this rests an angle in 6-ft. sections, loosely held by bolts in slotted holes, as shown in Fig. 4. The pressure of the water tends to hold this packing angle against the face of the dam, and any solid obstruction passing down would force the angle back and so be free to pass without injuring the dam or packing. Brass pipes held against the end walls of the dam chamber by light springs and the water pressure form the packing at the ends of the dam. These pipes move against steel plates embedded in the concrete of the end walls, but machined cast-iron plates would give a better surface where a close fit is desired. The hinge joint is also made watertight.

The clearance and packing between the movable dam and the walls of its chamber are devised to confine the water in this chamber beneath the dam. Water is admitted to and discharged from this chamber through controlling valves. Air pipes are placed under the deck in order to maintain a free water surface in the chamber at all times. The chamber has lugs and recesses for the support of falsework used in erecting and overhauling the dam. It has also a set of movable dogs for holding the dam in its raised position, as noted above. In case of emergency, the opening may be closed by a needle dam composed of vertical timbers. Provision is made for stepping these on the wall-plate of the breast wall. The upper ends would rest against the plate-girder bridge spanning the opening, the bridge floor being made very stiff horizontally in order to distribute over both girders the pressure due to the head of water against the needles.

The operation of the dam is very similar to that of a bear-trap dam. The pressure due to the head of water under the dam balances both the weight of the dam itself and that of the water flowing over it. This equality of moments exists under all positions of the dam. The dam being thus maintained in equilibrium, it may be raised or lowered by raising or lowering the head of water in the dam chamber. The head is controlled by a special valve called a weir-tube. This valve is a 26-in. vertical cylinder which moves vertically and has its lower end sliding in a cylindrical conduit connecting with the chamber. The rim of the cylinder forms an annular weir. This cylinder is raised and lowered by mechanism in the operating house. The head of water required in the dam chamber is always lower than the available head in the upper bend of the canal. The arrangement of the operating mechanism is shown in Fig. 3.

The operating house is placed upon the wall separating the two dams. It is of concrete-block construction, 12 × 26½ ft. in plan. It covers three pits in the dividing wall, as follows: (1) the weir-tube pit; (2) the indicator pit; (3) the inlet pit. The weir-tube pit contains two removable weir tubes controlling the water levels in the two dam chambers, as described above. It is drained by a conduit. The sluice valves in this conduit afford an alternative method of con-

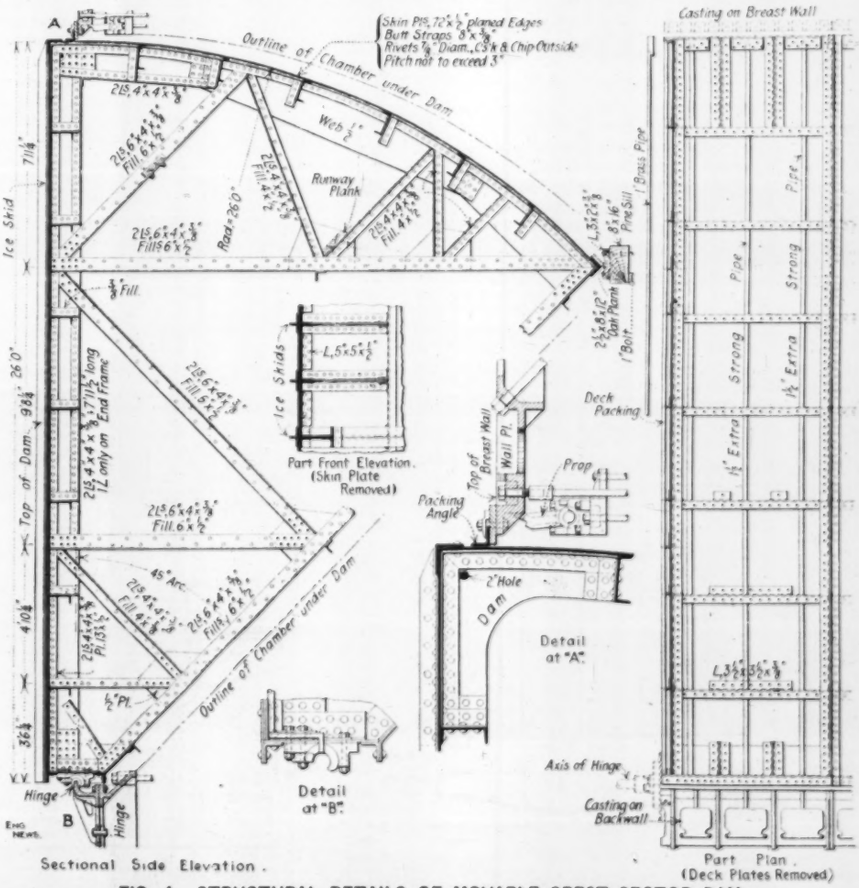


FIG. 4. STRUCTURAL DETAILS OF MOVABLE-CREST SECTOR DAM.

trolling the water level and the position of the dam in case the weir-tubes should be out of order. The indicator pit has openings communicating with the dam chambers and the conduit of the weir-tube pit. It contains a shaft and crank from each dam, connected to models or indicators in the operating room which show the positions of the dams at all times. It also contains the counterweights of the weir-tubes, and four float-gage wells of 12-in. pipe. The float-gage connections indicate the stages of water in each dam chamber and above the dams. The inlet pit is divided into three wells or compartments, the two outer wells communicating with the dam chambers.

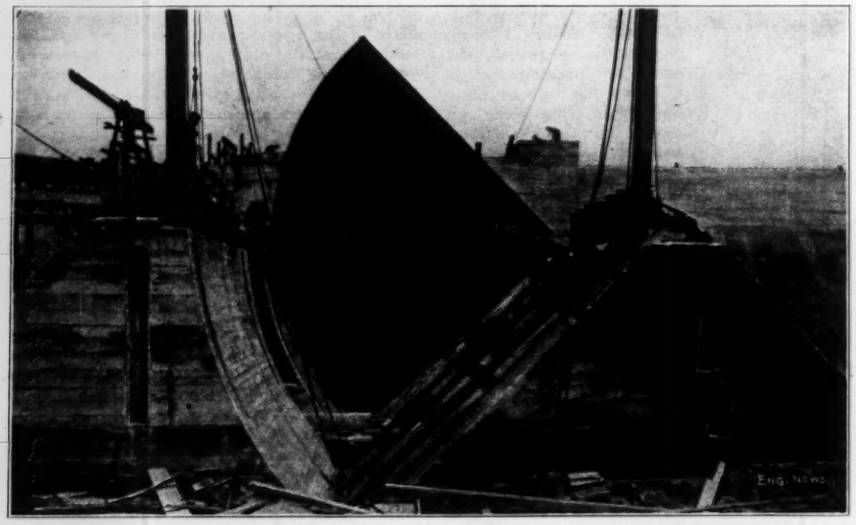


FIG. 5. A MOVABLE-CREST SECTOR DAM UNDER CONSTRUCTION.
(The Curved Face is the up-stream side.)

LOCK AND LOCK GATES.

The Drainage Canal crosses the line of the Illinois & Michigan Canal, and the canal boats now use the former near Lockport, a portion of the latter having been abandoned. In order to provide for this navigation, the dam has a lock 117 × 22 ft. in the clear, with a lift of 34 ft. Its location is shown in Fig. 1, while Fig. 9 shows sections of the lock, with its conduits and valve wells. Fig. 7 is an interior view of the lock and shows its great depth.

In each side wall of the lock is formed a filling and emptying conduit. This connects vertical shafts or valve wells above and below the lock, and has lateral channels opening into the lock. The valve wells are 5 ft. 2 ins. diameter, and in each well is a steel cylinder about 4 ft. 8½ ins. diameter. This cylinder forms the valve, and has at its lower end a ring which takes a bearing upon a cast-iron ring or valve seat embedded in the concrete, as shown in Fig. 8. At the top of the cylinder is a cast-steel spider to which the operating cables are attached, and through which passes a 2½-in. steel rod whose lower end is screwed into the bottom spider of the valve ring. Near the bottom and top of the cylinder are four 6½-in. rollers on horizontal shafts inside the shell. These rollers extend through holes in the shell, and their 2-in. faces ride upon the heads of vertical 60-lb. rails. These rails are riveted to rectangular frames of steel and the frames and rails are embedded in concrete of the well. Each valve is operated by an electric hoist driven by a 250-volt direct-current motor of 6 HP.

The cylinders are of telescope construction, made thoroughly watertight, and ring all joints calked. Those for the upper outlet valves are about 16 ft. long; those for the lower or outlet valves are about 47 ft. long. The construction of the cylinders, with the details of the rollers and valve seats, etc., are shown in Fig. 8.

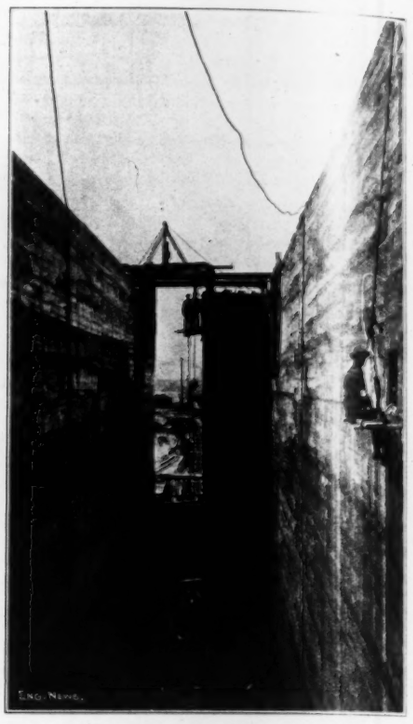


Fig. 7. Interior of Canal Lock for 34-Ft. Lift.

The lock is fitted with double-leaf gates, and has guard gates in the channels above and below the lock. The lock gates are 22 ft. 10 ins. high and 56 ft. 10 ins. high for the upper and lower ends, respectively; the guard gates are 16 ft. 10 ins. high. They are all built of single horizontal courses of Oregon fir timber, varying in section from 13¾ × 11¾ ins. at the top of the gates to 11¾ × 20½ ins. at the bottom of the high gates. The timbers are fastened together by white-oak keys and vertical through bolts. On each side of the gate are vertical timbers 6 × 6 ins. and 10-in. vertical channels, all secured by ⅞-in. through bolts in each course of horizontal timbers. Steel rods extend diagonally across the faces. They are looped over pins in the steel channels, and are drawn tight by means of turnbuckles. In the high gates, flat bars are used instead of the rods. The details of the gates are shown in Fig. 6. The miter sills are of white oak, 18 × 18 ins. The quoins are 15-in. steel channels, each carried by a 15-in. I-beam quoin post.

The lock gates are operated by wire cables which are led through wells in the lock walls and pass over the necessary guide sheaves. The two leaves of each gate are connected by synchronizing ropes which ensure uniform movement of both leaves during operation. All the ropes are ⅝-in. extra-flexible wire cables covered with a special waterproofing composition. At the top of each rope well is a driving sprocket wheel over which passes a length of sprocket chain to which the ropes are attached. The shafts of the sprocket wheels are driven from electric motors by means of gearing. There are two sets of operating machinery, which can be used together or independently. Each set has a motor of 6 HP., operating on 250-volt direct-current. The guard gates are operated by hand.

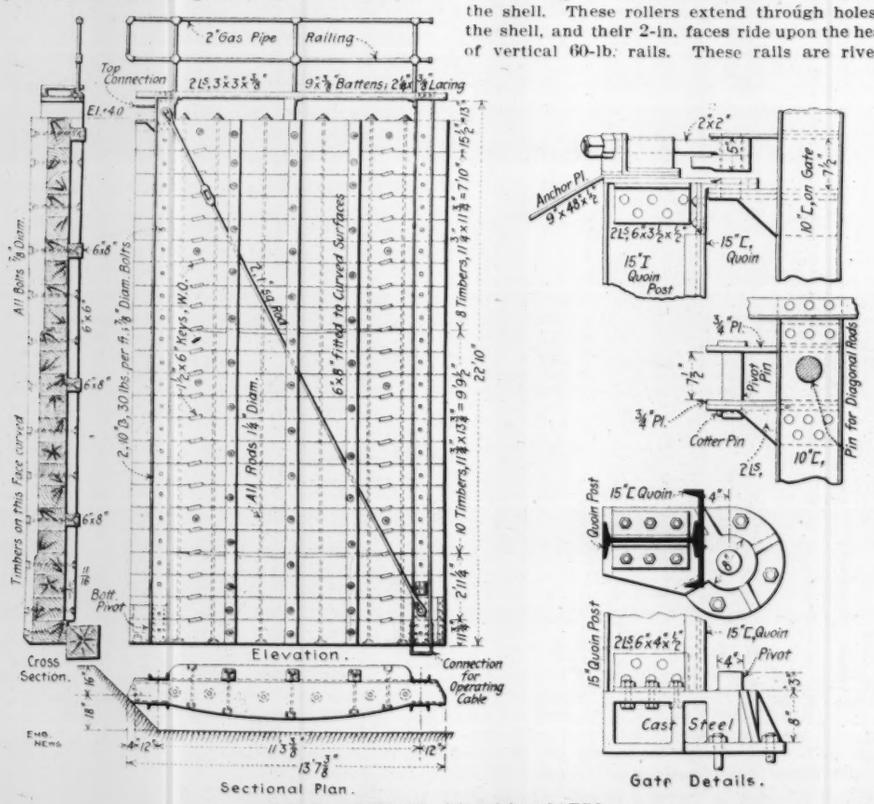


FIG. 6. DETAILS OF LOCK GATES.

All the masonry work of the lock and dams is of concrete, made with broken stone and limestone screenings. The proportions vary from 1:2½:4½ to 1:4½:9 in different parts of the work. All proportions are by volume, with cement taken at 95 lbs. to the cubic foot. The concrete was specified to be so wet that "the mass when disturbed will quake like fresh liver, but must not be so wet that water stands upon the surface." A wetter concrete was required for the walls of the movable dams, however, in order that these walls might be watertight. It was specified that for this part of the work "the water in the concrete when placed shall always stand in tracks or prints in the surface, but not on the surface of the concrete." The conduits of the lock are lined with hard-burned brick.

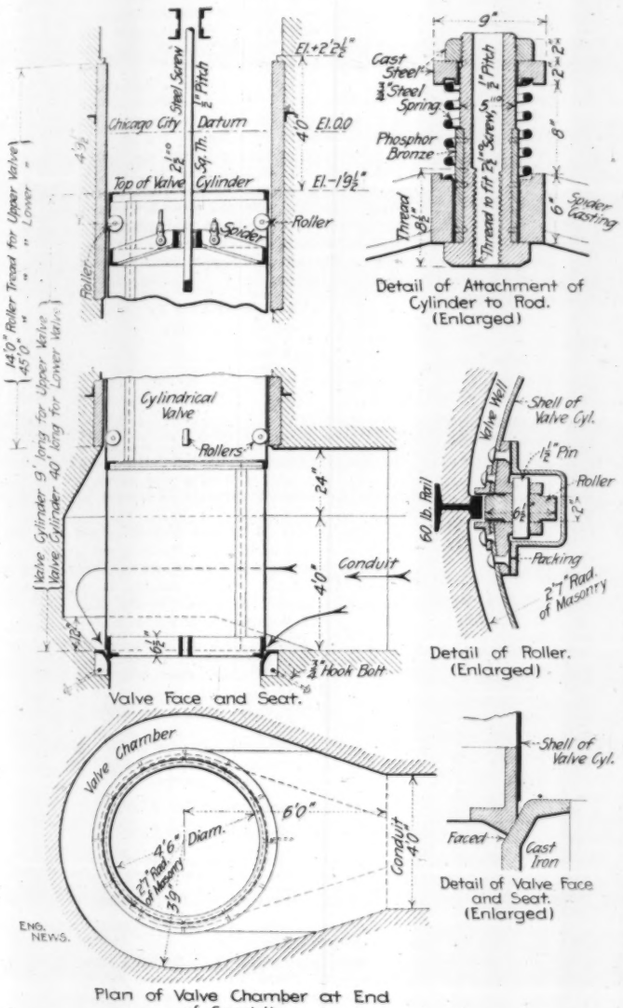

Detail of Attachment of Cylinder to Rod. (Enlarged)
Valve Face and Seat.
Detail of Roller. (Enlarged)
Plan of Valve Chamber at End of Conduit.
Detail of Valve Face and Seat. (Enlarged)

FIG. 8. TUBULAR VALVES FOR LOCK.

A SUGGESTION FOR THE SURFACING OF CONCRETE MASONRY.

By ELWYN E. SEELYE.*

The most common defects in the finished surface of concrete masonry are discoloration, scaling and hair cracks. Discoloration may be due to the use of different brands of cement in the same wall, to a lack of uniform color of the sand, to the concrete being non-homogeneous in mixture, or to the use of neat cement or cement mortar paints. Scaling is due to the plastering or painting of the wall with a rich or neat mixture. The fretwork of fine cracks is due to the common practice of using a cement mortar facing against the face forms. The appearance of these cracks is readily explained by the fact that the amount of shrinkage of concrete in setting is less than that of cement mortar.

The following method of surfacing concrete should eliminate all of the above defects and give a smooth and durable finish. Prepare a smooth and tight form, oiled, and in accordance with the usual instructions. While laying the concrete pry back the body mass with a flat bladed tool. This is not for the purpose of forcing the mortar to the front as is sometimes supposed, but to prevent the arching of the stones against the forms and the production of voids in the surface. A convenient tool for this purpose is made by welding a piece of steel plate to a rod. After the concrete has attained a consistency which will allow of the removal of the face form, but when it is still green and tender, go over it with a calcimine brush and plain water until the marks of the forms have been entirely removed. When the masonry has hardened the surface may be rubbed smooth with a carborundum brick or a briquette of cement mortar. It is important that the concrete be kept damp during the process of setting; otherwise the surface may dry out and leave insufficient water for crystallization. This may be done by covering the masonry with a wet tarpaulin and keeping it damp.

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AN INTERLOCKING SWITCHSTAND FOR OUTLYING SWITCHES.

The necessity of the elimination of the dangers incident to unprotected switches in main tracks has been pointed out many times, and was discussed in our issue of March 28, 1907. For switches outside of interlocking plants, and on the open line where the block-signal system is not in use, one of the simplest methods of affording the necessary protection is to install a distant signal which is so connected or interlocked with the switch that it will indicate "stop" whenever the switch is open for the siding.

One of the latest devices of this kind is a switchstand which operates both a switch lock and a distant signal, and in which the mechanism is so interlocked that the distant signal on the main track can indicate "proceed" only when the switch is set and locked for that track. On the next page is a view of the switchstand and switch, but does not show the signal connections. All movements are effected positively by gears, and a special feature of the gears is that they are intermittent. Thus the signal operating gear is not operative until the locking gear has completed its function, and the locking gear is not operative until the main gear has moved the switch points to their proper position.

There is a single lever, which is shown at the left of the switchstand. With the lever in the horizontal position (as shown) the switch is open, or set for the siding. To close it, the lever is moved 90° to a vertical position; this operates a gear which is connected to the switch rods and thus moves the switch rails so as to set them for the main track. With this movement completed, the gear is locked in position and remains locked while the other functions are being operated. This gear makes a turn of 180°, so that the crank of the operating shaft is on the dead center when the switch is set for either track.

A further movement of the lever of about 45° operates a gear which effects the locking of the switch by means of a plunger passing through the locking bar. This second gear is then locked and so remains while the lever is again moved through 45° to a horizontal position at the right of the switchstand. This last movement of the lever operates two gears simultaneously. One of these turns the target (and lamp) shaft 90° on its axis, so as to change its indication from "stop" (or "switch open") to "proceed" (or "switch closed"). The other gear gives a 180° turn to a grooved sheave carrying a chain which is connected to the distant signal.

The operating lever has thus one motion (parallel with the track) but performs three consecutive operations: (1) it throws the switch points; (2) it locks the switch; (3) it clears both the home (switch target) and distant signals. In the reverse movements, it first sets the signals at the "stop" position, then unlocks the switch, and finally opens the switch for the siding. It will be understood, of course, that if in closing the switch the point rail does not make its full travel, so as to come home properly against the stock rail, the locking plunger will not enter the hole in the locking bar. Then the lever will not move beyond the vertical position. As the gears operating the signal do

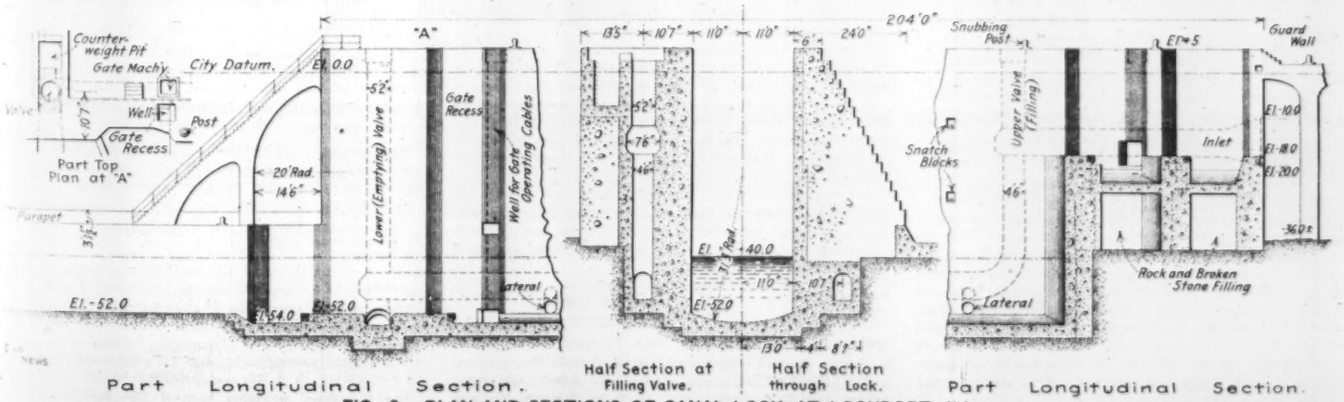


FIG. 9. PLAN AND SECTIONS OF CANAL LOCK AT LOCKPORT, ILL.

not engage until the lever has made its second or locking movement (45°), the signals cannot be cleared until the lever has completed this locking movement.

The lever can be padlocked only when it is in one of the extreme positions, with the switch properly set and the signals indicating the position of the points. When it is desired to switch cars out upon the main track, and under the protection of the distant signal, the switch alone can be operated by moving the lever through its first 90° travel. This will open and close the switch, but will not lock the switch or clear the signal. Should the switch operating rod be disconnected, or the switchstand be destroyed or removed, while the switch is set for the main track, the lock will still hold the points securely in position. The connection of the locking bar to the points can be made with the bar below the tops of the ties, and protected from anything that might drag out the switch tie-rods.

The switchstand is simple in construction, and easy to install and operate. It can be set to lock the switch in either position, and for points facing in either direction. The interlocking device is attached to a plate separate from the

Interlocking Switch-Stand for Outlying Switches.
(Frank M. Foster, Columbus, Ohio, Inventor.)

switchstand, and is spiked in place before the latter is erected. The switchstand is then set over the plate and spiked down in position. All working parts are of malleable iron. The driving gear (operated by the lever) is a single malleable casting, having three sets of teeth so arranged as to engage each driven gear at the proper time. Each driven gear remains locked against the surface of the driving gear until the teeth engage and turn it through the proper angle, when it is again locked.

This interlocking switchstand has been invented and patented by Mr. Frank M. Foster, Columbus, O. (P. O. Box, 35, Station A.) In its design he had the assistance of Prof. Stillman W. Robinson. The first one made (which is shown in the accompanying cut) is in service near the Toledo & Ohio-Central Ry. passenger station at Columbus. Here the switches and signals are under control of an interlocking plant, and the distant signal is not required. The location was selected, however, in order to have the device convenient for operation. The switchstand is to be manufactured by the Robinson-Tilton Machinery Co., of Columbus, O.

THE STEAMSHIP "GEORGE WASHINGTON" of the North German Lloyd was launched at Bredow, Germany, Oct. 31. This vessel, the largest German-built and owned steamer afloat, has a length of 722 ft. 5 ins.; beam, 78 ft.; depth from upper saloon deck, 54 ft.; depth from awning deck, 80 ft.; displacement at draft of 33 ft., 36,000 tons. She will carry 2,941 passengers and has a cargo capacity of 13,000 tons. Two four-cylinder, quadruple expansion engines of 20,000 I. HP. will give her a speed of not less than 18.5 knots.

THE SAFETY AND CARRYING CAPACITY OF THE BLACKWELL'S ISLAND BRIDGE: TWO EXPERT REPORTS.

The Blackwell's Island Bridge over the East River at New York City, which is now nearly ready to be opened to traffic, has been found to be too weak to carry the load for which it was designed. The two expert reports printed below, set forth in detail the condition of this great structure. Doubts concerning the safety of the structure were aroused when the Quebec bridge fell a year ago, but nothing definite was done to determine the real situation until June. At that time the public uneasiness became such that two expert engineers were appointed to make complete and independent investigations of the bridge and present reports as to its safety and carrying capacity. The experts appointed were Mr. Henry W. Hodge, and Prof. Wm. H. Burr. The former carried out his investigation with the staff of the firm of Boller & Hodge, while the latter employed the force of the Department of Bridges.

It will be seen by study of the reports below that both investigators find the greatest loading assumed in the original design to be such as would greatly overstress the main truss members, and that such a loading therefore would be unsafe. The experts are silent as to how the bridge came to be built with stresses so far above those permitted in the specifications. From the best information at hand we believe that the dead weight of the structure was largely increased in revision of the design over what was originally contemplated and there was also a belated decision to provide for four elevated railway tracks instead of the two originally proposed.

The final conclusion of Messrs. Boller & Hodge is that the greatest permissible loading, besides the highway and footway traffic is only the four trolley car lines, *with no elevated-railway load*, and to make even this loading safe, *it will be necessary to take off dead weight to the amount of 1,000 lbs. per lin. ft. of EACH TRUSS*, or several thousand tons for the entire bridge. Prof. Burr finds means for permitting the use of two elevated tracks besides the four trolley tracks, but he accomplishes this only by specifying a wider spacing for the trolley cars than that assumed by Boller & Hodge, and by a greater reduction of dead weight.

The bridge therefore as it stands, can safely carry not more than one-third of the intended live load. By taking off dead weight this capacity may be increased to somewhat more than *one-half* the intended load.

The valuable load diagrams and stress-sheets which accompany the reports, unfortunately exceed our limits of space, but we hope that the Department of Bridges will make them available for circulation among bridge engineers. But neither report, remarkably enough, contains a stress-sheet for the designed load, that is, for the conditions of the specification, so that the real deficiencies of the bridge are not set forth plainly.

The reports, in full, are as follows [italics ours, as are also most of the headings, inserted to emphasize the salient features of the reports]:

Report of Boller & Hodge.

Hon. Jas. W. Stevenson, Commissioner of Bridges, City of New York:

Dear Sir: In accordance with the resolutions of the Board of Estimate and Apportionment, dated June 5, and your instructions of June 9, 1908, we have made a careful investigation of the carrying capacity of the Blackwell's Island Bridge over the East River, and hand you herewith a full report of the results of this investigation, accompanied by ten drawings, and one appendix.

We beg to say that your department has put all the records and data of this entire structure at our disposal, and has extended every assistance and courtesy in aiding us to arrive at the necessary facts on which our investigation is based.

Yours very truly,
Boller & Hodge,
Consulting Engineers.

REPORT ON THE CARRYING CAPACITY OF THE BLACKWELL'S ISLAND BRIDGE.

The Blackwell's Island Bridge in New York City, across the East River, extends from Sixtieth St. and Second Ave., Borough of Manhattan, to [illegible] Ave. and Jane St., Borough of Queens, a distance of about 8,600 ft., made up of steel viaduct approaches at each end with a cantilever structure over the [illegible] channels and over Blackwell's Island, having a length of 3,724½ ft. between anchorages, with spans as shown on Diagram No. 1. [Fig. 1 herewith.—Ed.]

This cantilever structure differs from the usual type in having the lower ends of each shore [illegible] attached by a rocker arm to the upper ends of the island lever arm, thus making the entire structure continuous.

In accordance with our instructions we have confined our investigation to the cantilever structure, and all of our findings apply only to that portion of the bridge between the anchor piers.

This cantilever was originally designed to carry a 35½-ft. driveway, two 11-ft. sidewalks, four lines of trolley cars and two lines of elevated railway, arranged as shown on Diagram No. 2.

The contract for this structure was let to the Pennsylvania Steel Co. on November 20, 1903, and this contract design as shown by the lithographed album of drawings, together with the printed specifications issued with this album of drawings, will hereafter be referred to as the original design. It was estimated that the weight of the original design would be 84,[illegible],000 lbs., made up as follows:

ORIGINAL ESTIMATE OF WEIGHT.

Nickel-steel eyebars	12,[illegible],000 lbs.
Nickel-steel pins	1,[illegible],000 lbs.
Structural steel eyebars	[illegible],000 lbs.
Structural steel pins	[illegible],000 lbs.
Structural steel, other than eyebars and pins	69,[illegible],000 lbs.
Steel castings	1,[illegible],000 lbs.
Total	84,[illegible],000 lbs.

But the final sections and details had not been made when this estimate of weight was given, so the full data for an accurate estimate of weight did not then exist.

In September, 1904, it was decided to add two more lines of elevated railway to the original design, and these were to be arranged as shown on Diagram No. 3, the sidewalks being placed outside of the trusses. [This arrangement corresponds to Fig. 2.—Ed.]

But it was determined that the four elevated tracks would not be immediately needed, so the bridge is now built with the outside footwalk stringers and the overhanging ends of the upper floor beams omitted, with the sidewalks placed (for the present) in the place of the two outside elevated tracks, as shown on Diagram No. 4. [See Fig. 3.—Ed.]

SPECIFIED LOADS.—The original specifications called for a "congested" live load of 12,600 lbs. per lin. ft. of bridge, made up as follows:

2 Elevated railway tracks, at 1,700 lbs. per lin. ft.	= 3,400 lbs.
4 Trolley railway tracks, at 1,000 lbs. per lin. ft.	= 4,000 lbs.
35½-ft. roadway, at 100 lbs. per sq. ft.	= 3,550 lbs.
2 11-ft. sidewalks, at 75 lbs. per sq. ft.	= 1,650 lbs.
Original loading, per lin. ft. of bridge	12,600 lbs.

and a "regular" live load of one-half the amount, or 6,300 lbs. per lin. ft.

But when adding the two additional lines of elevated railways these loads were increased by the weight of these two additional tracks, giving a "congested" live load of 16,000 lbs. and a "regular" load of 8,000 lbs. per. lin. ft. of bridge.

These uniform loads were specified for the main truss members only, and the floor systems and secondary truss members were to be designed for the following live loads:

On each elevated railroad track [cars of four axles spaced 6 ft., 10 ft., 6 ft., the axle-load being 26,000 lbs.].
On each street car track [cars of two axles spaced 10 ft., the axle-load being 26,000 lbs.] or 1,800 lbs. per lin. ft. of track.
On any part of the roadway 48,000 lbs. on two axles 10 ft. apart and 5 ft. gage covering a space 12 ft. × 30 ft.; and 100 lbs. per sq. ft. on the remaining roadway surface.
On the footwalk a load of 100 lbs. per sq. ft.

The dead weight was specified to be the weight of the structure and floor, without any allowance for snow.

The wind load was specified to be 2,000 lbs. per lin. ft. of bridge, of which 1,000 lbs. was assumed to be a moving load and 1,000 lbs. a fixed load.

SPECIFIED MATERIAL.—The specifications state that some of the eyebars and pins will be of nickel-steel of the following chemical requirements:

	Per cent., Max.
Phosphorus (Basic)	.04
Phosphorus (Acid)	.06
Sulphur	.06
	Per cent., Min.
Nickel	3.25

The annealed specimens of this material were required to have the following physical values:

Elastic limit .....48,000 lbs. minimum per sq. in.
Ultimate strength.....88,000 lbs. minimum per sq. in.
Elongation in 8 ins....1,600,000 ÷ ultimate strength.

The full sized annealed bars of this material up to

a maximum size of 16 ins. × 2½ ins.) were required to show the following results:

Elastic limit .....48,000 lbs. minimum per sq. in.
Ultimate strength.....85,000 lbs. minimum per sq. in.
Elongation in 18 ft....9%

All other material in the structure was to be of open-hearth steel, specimens (except rivets and steel castings) to show the following chemical results:

	Per cent., Max.
Phosphorus (Basic)	.04
Phosphorus (Acid)	.08
Sulphur	.05

and to have the following physical values:

Elastic limit, plates and shapes .....30,000 lbs. per sq. in. minimum.
Elastic limit, eyebars..½ of ultimate.
Ultimate strength, plates and shapes...60,000 lbs. desired.
Ultimate strength, eye-bars.....66,000 lbs. desired.
Elongation, per cent. in 8 ins. .....1,500,000 ÷ ultimate strength.

and annealed full-size eyebars to show results as follows:

Elastic limit .....28,000 lbs. per sq. in. minimum.
Ultimate strength.....56,000 lbs. per sq. in. minimum.
Elongation in body of bar, 10%

PROPER MATERIAL OBTAINED.—We have examined the detailed reports of the mill inspectors on this material, and find that they show the metal fulfilled the above specifications.

We also computed, from the various contract drawings, the weight of the flooring material, including paving blocks, roadway concrete, sidewalk concrete, rails, ties and other materials for the various tracks, railings, pipes, wires and all other material required on the structure. We also figured the amount of steel which will be required at some future time to complete the two sidewalks in their final position and all of these weights were found to be as follows:

ACTUAL WEIGHTS EXCEPT SHIPPED STRUCTURAL STEEL.

(In lbs. per lin. ft. of bridge.)

2 outside footwalk stringers.....176		
Overhanging footwalk brackets....100	Add'l steel..	403
Footwalk gratings 127		
2 upper outside railings.....142	.....	232
2 upper inside railings.....90		
Reinforced concrete slabs for footwalk.....		500
Rails and contact rails for four upper tracks.....		330
Guard timbers and ties for four upper tracks.....		640
2 lower railings		174
Rails and conductor rails, 4 lower tracks.....		375
Wood paving blocks of roadway.....		1,041
Concrete under roadway paving blocks.....		3,200
Pipes, mail chutes, telephone, telegraph and feeder wires		405
		7,300

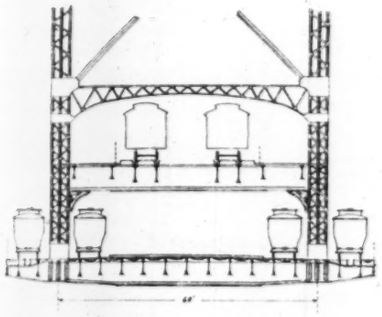
This total load of 7,300 lbs. per lin. ft. of bridge is referred to in this report and on the drawings as "additional material," being all the dead load except the shipped weight of structural steel.

Live Load. In accordance with the terms of the specifications, we have assumed the live load to be "placed so as to give the greatest strain in each part of the structure," and this condition requires that some sections of the bridge may be loaded and at the same time other sections unloaded; for instance, the maximum compression in the rocker arms occurs with the two island lever arms and the two shore anchor arms loaded and the other portions unloaded, and the maximum tension in these rocker arms occurs with the two shore lever arms and the island span loaded and the other portions unloaded.

For the secondary members, except in a few cases where the bottom chord is not straight between adjacent main panel points, the live load stresses were figured with the local loads specified.

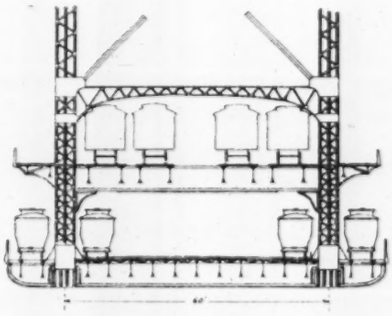
As the two rocker members connecting the ends of the lever arms cause the adjacent ends of the lever arms to move up and down together, the structure is continuous from end to end for live load stresses, and these stresses cannot be computed by the usual static method and must be found by means of the elastic properties of the materials.

DIAGRAM No. 2



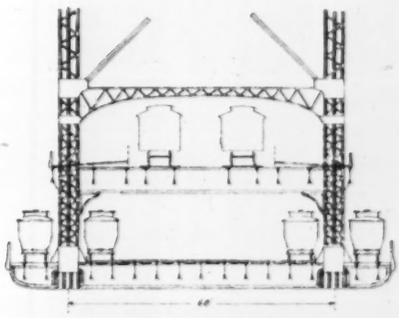
As Designed.
(Two Elevated Tracks, Footwalks Inside.)

DIAGRAM No. 3



As Altered.
(Four Elevated Tracks, Footwalks Outside.)

DIAGRAM No. 4



As Built.
(Two Elevated Tracks, Footwalks to be Shifted When Changing to Four Tracks.)

SPECIFIED UNIT-STRESSES.—With the above loads and quality of material, the following unit-stresses were specified:

	For dead load and regular live load or for dead load and wind.	For dead load and congested live load.
	Lbs. per sq. in.	
For Nickel-Steel in Eyebars and pins:		
Tension	30,000	39,000
Shear on pins	20,000	24,000
Bearing on diameter of pins	40,000	48,000
Bending on outer fiber of pins	40,000	48,000
For Structural Steel in Main Members of Trusses, Towers and Bracing:		
Tension	20,000	24,000
Compression	20,000-90 l/r*	24,000-100 l/r*
Shear on shop rivets, bolts and pins	13,000	16,000
Bearing on diameter of shop rivets, bolts and pins	25,000	30,000
Bending on outer fiber of pins	25,000	30,000
For Structural Steel in Secondary Members of Trusses:		
Tension in sub-verticals (hangers)	18,000	
Compression in sub-diagonals	18,000-80 l/r*	
Shear on shop rivets and bolts	12,000	
Bearing on diameter of shop rivets and bolts	24,000	
For Structural Steel in Floor System of Roadway and Footways and in all Floor Beams:		
Tension chords	15,000	
Shear on shop rivets, bolts and web-plates, net section	10,000	
Bearing on shop rivets and bolts	20,000	
For Structural Steel in Floor System (including brackets) for Railroad and Trolley Tracks:		
Tension chords	10,000	
Shear on shop rivets, bolts and web-plates, net section	7,000	
Bearing on shop rivets and bolts	14,000	
Allowable pressure on masonry	550	650

*Where l = length and r = radius of gyration, both in inches.

These specifications and the original contract drawings, which show the general dimensions of the bridge as built, form the basis of our investigation, and in addition thereto we used the detailed shipping invoices showing the exact scale weight of each and every piece in the structure, and the detailed shop drawings showing the areas of the sections.

CALCULATION OF STRESSES.—From the above data we have carefully computed the live and dead stresses and unit stresses in each and every member of the structure, making our calculations on the following basis:

Dead Load. We have taken for the dead load the scale weights of each piece as shipped and given on the various invoices, and we have apportioned these shipping weights to their proper panel points, arriving at the panel point dead load as shown in detail on sheets 1 to 3, inclusive. To these scale weights of structural material, we have added the weight of "additional material" as heretofore given; this material being taken as uniform along the entire length of bridge, and apportioned to the panel points in proportion to the panel lengths. These two items constitute the entire dead load of the completed structure, and the resulting panel loads are shown in detail on sheets 1 to 3 and are summarized on sheets 4 to 6, which latter sheets show the points of application as used for the dead load calculations.

The actual shipping weight of steel now in the structure as at present finished (as shown on Diagram 4) is 105,152,010 lbs., made up as follows:

ACTUAL WEIGHT OF SHIPPED STRUCTURAL STEEL.

Nickel-steel eyebars.....	9,179,133 lbs.	
Nickel-steel pins.....	1,460,563 lbs.	
Nickel-steel links and pin plates	1,010,034 lbs.	
Nickel-steel castings.....	119,900 lbs.	
Total nickel-steel		11,769,630 lbs.
Structural steel eyebars....	5,654,400 lbs.	
Structural steel pins.....	38,566 lbs.	
Structural steel other than eye-bars and pins.....	84,795,779 lbs.	
Steel castings	2,253,004 lbs.	
Small iron castings.....	47,786 lbs.	
Cast-iron curb.....	592,755 lbs.	
Total structural steel.....		93,382,380 lbs.
Total weight		105,152,010 lbs.
This weight is distributed as follows:		
Towers		12,633,200 lbs.
Anchorages		995,500 lbs.
Trusses, bracing and floor.....		91,493,310 lbs.
Total		105,152,010 lbs.

The dead load stresses have been figured on the assumption that both rocker arms will be adjusted when the entire dead load is in place, so that no dead load will pass through them, thus making the dead load stresses entirely independent of these rocker arms and making their values computable by the ordinary static methods.

While this method is well known and has been in use for some time, we give in an appendix an adaptation of it to this structure, which takes into account the simultaneous action of both the rocker arms and gives a simple and precise method of computing their stresses for any given loading. [This adaptation has been worked out by Mr. Clarence W. Hudson, who has had charge of these calculations for us. [This matter is omitted here and will be reproduced in a later issue.—Ed.]

With the stresses in the rocker arms known, the stresses in all the other members of the structure may be readily computed.

In computing the deflections of this structure, we have used the gross area of all riveted tension members. We have allowed nothing for play of pin holes, and we have not considered the tie plates, battens, or lattice on riveted members, nor the influence of the lateral system or the buckle plate floor. All of these matters have some slight influence on the actual deflections, but as it is only the ratio of certain deflections that is used to determine the stresses, to a certain extent one influence offsets the other, and the stresses thus determined are not subject to serious error. We have computed deflections, using a modulus of elasticity of 28,000,000 lbs. for both carbon and nickel steel.

Wind Loads.—We have computed the wind stresses on the assumption that all wind pressure is transmitted by the transverse bracing directly to the lower chord, the upper horizontal bracing being for vibration only.

We have computed the stresses for a fixed load of 1,000 lbs. per lin. ft. over the entire structure and for an additional live load of 1,000 lbs. per lin. ft. placed so as to give the greatest stress in each member.

The wind stresses have been computed by the same general method that was used for the live load stresses in the main trusses.

The formulas for these wind stresses are similar in terms to those for the live load stresses, but differ in some of their signs due to the fact that a horizontal force at one end of either of the island lever arms produces motion at the end of the other lever arm opposite in direction to the force.

We only show the chord stresses on our stress sheet [the stress sheet is not included in the report, however—Ed.] as the web stresses cannot be given with accuracy since there is a solid buckle plate floor which carries a large portion of the wind shear.

Erection Stresses—We have computed the erection stresses, using a traveler weighing 647 tons, distributed as shown on sheet 10. This weight and spacing we have taken from the contractor's drawings (as this traveler had been removed before we started this investigation).

For the stresses in the island span we have assumed a traveler on the east and west lever arm simultaneously, and we have taken traveler weights in such positions as to give maximum strains in every member, with the outer limiting position of the forward wheels four panels from the ends of the lever arms.

In addition to the stresses caused by the travelers, we have computed the simultaneous dead load stresses, assuming that all the weight of steel was in place, but not including the weight of "additional material" (amounting to 7,300 lbs. per lin. ft. of bridge), none of which was placed on the structure until after the removal of the travelers.

All erection stresses have been computed by simple static methods as the rocker arms were not rigidly connected till after the removal of the travelers.

Snow Load—The specifications do not call for any snow load on this structure, so that we have not figured any stresses for such a load, but in our opinion, a bridge of this character, with a practically solid lower floor 87 feet wide and an upper deck with two sidewalks and four lines of railroad track, should have been calculated for a considerable snow load.

THE STRESSES EXCESSIVE.

We made a stress sheet for the loads called for in the specifications, but *it was evident that the structure could not safely carry these loads*, so we had to find the maximum safe carrying capacity of the structure. The final stresses under the conditions of safety hereinafter recommended are shown on our general stress sheet (Sheet No. 7) submitted herewith. This stress sheet also shows the effective area of each member, the final unit stresses, and the wind stresses in the chords.

The areas marked T for the main posts U17-L17, U57-L57, U75-L75, and U107-L107, are the areas at their points of maximum width, and these posts decrease in area towards their ends, as the side plates keep the same thickness but decrease in width, giving the areas marked B at the bottom. The areas marked T for the other vertical posts are exclusive of the area of the transverse diaphragms at these posts, and the areas marked B are inclusive of these diaphragms.

We have made no additions for reverse stresses, as the specifications state that the sections are to be computed for the stress requiring the greatest area, so that the unit stresses here shown are the direct stresses from dead and live loads without any additions for reverse stresses, snow, wind, impact, or secondary stresses.

THE FLOOR STRESSES IRREGULAR.

We have also computed the stresses in many of the floor beams and stringers for the upper and lower floors, using the local live loads specified, and for the cases computed we find the maximum flange stresses to be as tabulated below.

All of these stresses are for the static loads without impact.

The two pairs outside trolley stringers on the lower floor are built of certain sections on the island span and its lever arms, and of the same sections (for similar panel lengths), with additional cover plates on all other portions of the structure, thus making some portions of these tracks much stronger than others, as shown by the above stresses.

We are informed that the island span and lever arm outside stringers had been completed for the specified trolley loads, when it was decided that subway trains might be run on these tracks and the remaining outside stringers were cover-plated. This, however, leaves these tracks without uniformity as to carrying capacity, unless cover plates are added to the outside stringers on the island span and its lever arms.

The upper floorbeams all have the same thickness of web, and the first cover runs the full length top and bottom, regardless of whether they carry a 20½-ft. panel or a 40-ft. panel, and this was undoubtedly done to carry the traveler during erection.

In a few of the lower floorbeams and trolley stringers, the unit stresses exceed those specified; and this excess has been caused by their having been computed for a dead load less than the actual weight as finally called for by the flooring contracts, but this excess is so slight that, in our opinion, it will not affect their safety.

THE ERECTION STRESSES LOW.

While the erection stresses are passed and can never recur again, we considered it advisable to compute these stresses to find if they had been greater than the stresses to which the structure may be subjected under traffic; and on sheet 10 we give the erection stresses for the chords and for such web members as will have the maximum erection stresses, though we did not consider it of sufficient value to compute all the minor web stresses from erection.

From this stress sheet we find that the maximum erection stresses in the chords do not equal the completed dead load stresses, and only in a few diagonals near the main piers do they equal the specified live and dead load stresses; so they furnish no data in the way of a full-size test to determine the carrying capacity of the members, as the structure under traffic will be subjected to greater stresses than it was during erection.

THE FOUNDATIONS SUFFICIENT.

We have examined the general design and details of the anchorages at the Manhattan and Queens ends and find the sections and the weight of masonry sufficient to carry the uprights. We also find the pressure on the masonry of the main piers to be within safe limits.

THE SECONDARY STRESSES NOT IMPORTANT.

We have not made a complete investigation of the secondary stresses in this structure, but we have made a limited investigation to approximately determine what the secondary stresses caused by temperature, distortion due to deflection, and bending due to own weight of members, amount to.

We find that the secondary stresses due to temperature are generally small, except in the post U75-L75, where, in our opinion, the maximum stress from this source will occur, as this is the free end of the Island span, and a variation of ± 60° F. will move the top of this post and bend it around its fixed lower end, producing a fiber stress of 3,200 lbs. per sq. in.

The secondary stresses due to distortion of the true figure of the trusses by the live load, are quite considerable, as the vertical deflection of the point L37 is 18⁵/₁₀ ins., and of the point L91, 14²/₁₀ ins. for a live load of 3,000 lbs. per 1 lin. ft. of truss.

We have made a careful analytical computation of the horizontal movement of the point U17 (and other similar points over the main piers) caused by this distortion, and for a live load of 3,000 lbs. per lin. ft. of truss in the position giving the maximum direct stress in the post U17-L17 we find this movement causes a fiber stress in the lower fixed end of U17-L17 of 2,600 lbs. per sq. in., which is the maximum stress from this source, which occurs simultaneously with a maximum direct stress. The fiber stresses in the other similar posts are about the same, except that for U75-L75 it is reduced to 1,400 lbs. per sq. in. owing to the fact that this is the free end of the Island span; but this should be added to the temperature fiber stress in this post as above given. This distortion also causes some horizontal movement of the top ends of the rocker arms relative to their bottom ends and this relative movement causes additional secondary stresses, but the s[illegible] found from this cause were so small as to be saf[illegible] gligible.

The fiber stresses due to bending of [illegible] rs from their own weight depends to some extent [illegible] the total live load and dead load direct stresses on [illegible] embers, but for a live load of 3,000 lbs. per lin. ft. [illegible] truss we find this fiber stress to be about 1,200 lb[illegible] sq. in. for many of the members, with extreme v[illegible] running as high as 3,500 lbs. per sq. in.

There are also secondary stresses due to [illegible]ct, and to bending in the vertical posts and hange[illegible] used by accelerating or retarding the moving loads [illegible] upper floor, but we have not computed any valu[illegible] these, as we are of the opinion that they are negli[illegible] in this structure where the relative value of live l[illegible] as compared with the dead load is so small.

The above maximum values of all the[illegible]ondary stresses will probably not occur in the sa[illegible]embers at the same time, but it will be seen that [illegible]y may cause considerable increases in the direct [illegible] stresses heretofore shown.

In addition to figuring the stresses on a[illegible] members we have had a large number of the actual b[illegible]se members measured and calipered in the field, and we find that they agree with the sections we took from the shop drawings and used in these calculations, which sections we show in detail on sheets 8 and 9.

We have also computed the weight of a number of members from the shop drawings and find such weights agree with the shipping weights on the invoices, showing that the scale weights used for the dead load are correct.

We have figured the net sections of the riveted tension members from the shop detail drawings.

We have not carefully examined all the details of this structure, but we have checked the end connections of such members as are most heavily stressed and find them equal in strength to those members.

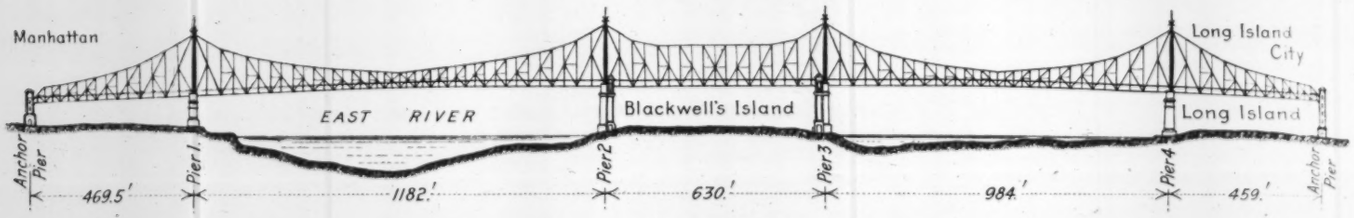


FIG. 1. GENERAL DIAGRAM OF BLACKWELL'S ISLAND (QUEENSBORO) BRIDGE.

(Approaches not included.)

THE STRENGTH OF THE LOWER CHORDS.

We have carefully considered the form and details of the lower chord as this feature has been criticised in the public journals, and the impression has been given that the lower chords in this structure are weaker than those of the Quebec Bridge, which, in our opinion, is not the case.

There is no full-size experimental data for the carrying capacity of such large compression members as are used in this structure, though the recent tests on models of compression members for the Quebec Bridge showed that such members when properly latticed carried 32,000 lbs. per sq. in. before failure, with a ratio of length to radius of gyration of 25. The only safety is to keep within the limits gained from experience on a smaller scale, as the means do not exist for learning the absolute carrying capacity of such sections, and a practical method of testing could not be provided in any reasonable time.

In our opinion, however, it is safe to follow the established practice for compression values, provided the limits set are not too high and the details are sufficient to make the member act as a unit and not fail in detail.

The heavier sections of the lower chord of this bridge are built up of four vertical webs, each 48 ins. deep and varying in thickness with the sections required. Each web has an 8-in. by 6-in. angle, top and bottom, forming a "built-up channel." Each outside pair of these "built-up" channels is latticed together, top and bottom, with 5-in. by ⅝-in. lacing bars, having two rivets in each end and one rivet at each intersection, the length of these lattice bars being about 45 ins. c. to c. of end rivets. This gives two separate built-up channel chords 48 ins. deep and 25 ins. b. to b. of angles. These two separate sections are then connected together with top and bottom tie plates 15 ins. long and ½-in. thick, spaced about 5 ft. c. to c. The entire chord is thus about 70 ins. wide, b. to b. of outside angles. While this chord is not as stiff transversely as it would be if properly latticed from outside rib to outside rib, and while in our opinion the lattice on the center line, where the longitudinal shear due to bending is at its maximum, should not have been omitted, yet we believe that the chord is as strong horizontally as vertically for the following reasons:

FLOOR STRESSES.

Lower floor trolley stringers with cover plates	from	4,600 lbs.	to	7,000 lbs.	per sq. in.
Lower floor trolley stringers without cover plates	from	7,200 lbs.	to	11,000 lbs.	per sq. in.
Lower floor roadway stringers	from	7,900 lbs.	to	14,600 lbs.	per sq. in.
Upper floor elevated railway stringers	from	6,500 lbs.	to	9,100 lbs.	per sq. in.
Upper floor sidewalk stringers	from	4,100 lbs.	to	10,800 lbs.	per sq. in.
Upper floor floorbeams	from	13,000 lbs.	to	14,400 lbs.	per sq. in.
Lower floor floorbeams	from	15,000 lbs.	to	16,000 lbs.	per sq. in.

The radius of gyration of the chord about its horizontal axis averages 14 ins. and the radius of gyration of each outside latticed pair of channels around a vertical axis averages 12 ins., without any allowance for the connecting of these two pairs by the tie plates, which certainly adds appreciably to the transverse stiffness, though the exact amount cannot be computed. However, the radius of gyration of the whole chord as a unit around a vertical axis is about 27, and while it would not be safe or proper to use this radius (owing to the omission of the central latticing), we consider it safe to assume that the tie plates add sufficient stiffness to increase the effective radius of gyration about a vertical axis from 12 to 14 and thus equal the vertical stiffness which of course sets the limit of stiffness for the section.

We have used for this chord a radius of gyration of 14, and all our results are based on this radius, and we are of the opinion that the details are sufficient to cause it to act as a unit with this radius.

The stress sheet shows that there are other compression members in the web system of the trusses which have higher unit stresses than the lower chord, with a greater value of l/r, so the safety of the bridge is not alone determined by the value of this chord.

We have made a careful examination of the bridge as now completed, and find no evidence of loose rivets or buckling of members, or other indications of overloading, but there are four sub-diagonal posts, C56-L57 on both trusses, and L107-C108 on both trusses, which had a "wind" in them during erection, and this was corrected by riveting a cover plate on the top of each post.

It will be noticed that both of these members are "sub-diagonals" which in no way affect the main stresses and are only for the support of one local panel load, and the stress sheet shows that they will never be subject to heavy stresses, so they are evidently safe and the "wind" was probably due to a bend in the shop or during erection, or to a slight overrun in length.

From the above data we come to the following

CONCLUSIONS:

First—That the specifications are clear and explicit and cover all the necessary requirements for the material and workmanship of a first-class structure, but in our opinion the working stresses given are in excess of good practice.

Second—That the steel manufactured for this structure is first-class bridge material and in accordance with the specifications.

Third—That the workmanship of this structure is first-class and in accordance with the requirements of the specifications.

Fourth—That the erection and field riveting of the structure appears to have been done in a first-class manner.

Fifth—That the actual sections of the various members agree with the sections ordered on the working drawings and shown on our sheets Nos. 8 and 9, and that the shipping weights are correct.

Sixth—That the members of floor systems are safe for the specified local live loads.

Seventh—That the following unit stresses in the main truss members, viz.:

	Lbs. per sq. in.
Tension nickel steel bars	30,000
Tension structural steel bars and riveted members	20,000
Compression, structural steel, up to l/r = 20	19,000
Compression, structural steel, for l/r above 20	20,000-50 l/r

are the limit of safety for the direct stresses from the sum of the live and dead loads, as the secondary and snow load stresses heretofore referred to will add to these unit stresses and thereby increase the actual unit stresses.

Eighth—That the main truss members will not carry all the specified live loads for which this structure was designed.

Ninth—That the structure can safely carry a considerable live load in addition to its actual dead load.

As we, therefore, do not think the structure can carry all the specified live loads and yet is safe for considerable live load, we have tried to arrive at the actual live load which may safely come on this structure, using actual moving loads now in use on the subway, elevated and surface lines of the city.

THE CAPACITY OF THE BRIDGE.

The heaviest trolley car now actually in use in this city has four axles with a loaded weight of 15,500 lbs. on each axle, and an over-all length of 42 ft. 6 ins., giving an average load of 1,460 lbs. per lin. ft. of each trolley track. The heaviest elevated or subway motor car has two loaded axles of 30,800 lbs. each, and two loaded axles of 22,200 lbs. each, and an over-all length of 51 ft., giving an average load of 2,080 lbs. per lin. ft. track. The heaviest elevated or subway trailer car has four loaded axles of 17,500 lbs. each and an over-all length of 51.4 ft., giving an average load of 1,360 lbs. per lin. ft. track.

The average weight of an elevated or subway train made up of five motor cars and three trailer cars is thus found to be 1,810 lbs. per lin. ft. track.

The specified live load for the main trusses is 100 lbs. per sq. ft. on the roadways, and 75 lbs. per sq. ft. on the footwalks, and while we believe such loads are proper for designing local members of the floor system and secondary truss members, they are undoubtedly excessive for the main truss members, as no such load can possibly come on the entire width of the roadway and sidewalks for any considerable length of the structure. For the main truss members, we, therefore, consider a live load of 50 lbs. per sq. ft. on the roadway and sidewalks to be fully sufficient.

By trial, we find that the main trusses will safely carry a live load of 3,000 lbs. per lin. ft. of each truss, *if the dead load be reduced by 1,000 lbs. per lin. ft. of each truss.* Some of this dead load, consisting of the outer sidewalk stringers, floorbeam brackets, sidewalk gratings, and track material for the railway tracks on the upper deck has never been put on the structure, and some of the dead load now on can be omitted, thus decreasing the full dead load and permitting the use of the above live load. Furthermore, the average live load on the trolley tracks can be reduced by regulating the minimum spaces between same, as these units are so small that for the main trusses the load is practically uniform for the cars spaced at reasonable intervals. For the elevated railway tracks it is not possible to greatly reduce the effective load per lineal foot by regulating the intervals between trains, as these trains are long and heavy units, and if trains are spaced at intervals of three or more train lengths, they will fall in such positions as to practically produce the maximum stresses in important parts of the structure.

With these live loads, the roadway and footwalks produce a live load of 17¾ ft. + 11 ft. = 28¾ ft. @ 50 lbs. = 1,437 lbs. per lin. ft. of truss, and if we assume each trolley track to be loaded with cars at clear intervals of one car length or about 85 ft. c. to c., they will produce a live load of 2 × 730 lbs. = 1,460 lbs. per lin. ft. of truss, making a total live load of 2,897 lbs. per lin. ft. of truss, *which would require a reduction in the dead load of about 1,000 lbs. per lin. ft. of truss to meet the conditions of safety*, and this reduction can be readily made.

We, therefore, come to the conclusion that it is safe to run the four lines of trolley cars on this bridge as at present constructed, if the portions of the dead load not yet in place, and not required for highway or trolley service, be omitted, and if the four lines of inside track stringers on the upper deck be removed.

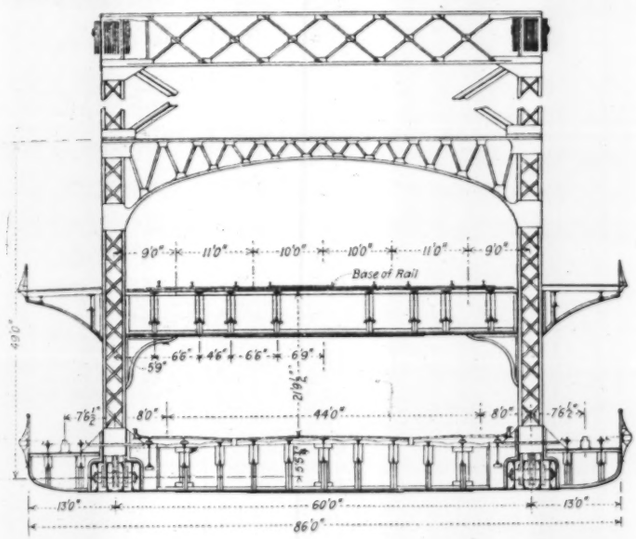


FIG. 2. WHEN COMPLETED ACCORDING TO THE LATEST PLANS OF THE DEPARTMENT OF BRIDGES.

(Four elevated-railway tracks on upper deck; four surface-street-railway tracks on lower deck (2 outside of trusses, 2 between trusses); 35½ ft. roadway on lower deck; two 11-ft. sidewalks on brackets alongside upper deck.)

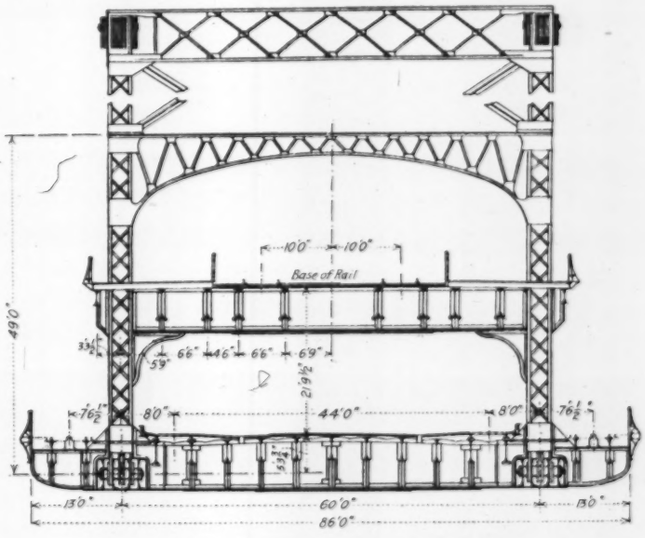


FIG. 3. AS BUILT FOR THE PRESENT.

(Sidewalk-brackets not erected, and sidewalk platform laid over outer pairs of elevated-railway stringers.)

NOTE: Boller & Hodge recommend that the inner pairs of elevated-railway stringers be removed, to lighten the weight of the bridge, and the sidewalks be left permanently in the location here shown, no elevated-railway trains to be run over the bridge.

FIGS. 2 AND 3. CROSS-SECTIONS SHOWING COMPLETED AND PRESENT CONDITIONS OF BLACKWELL'S ISLAND BRIDGE.

The "additional" dead load then will consist of the following items:

"ADDITIONAL" DEAD LOAD WHICH MAY SAFELY BE RETAINED.

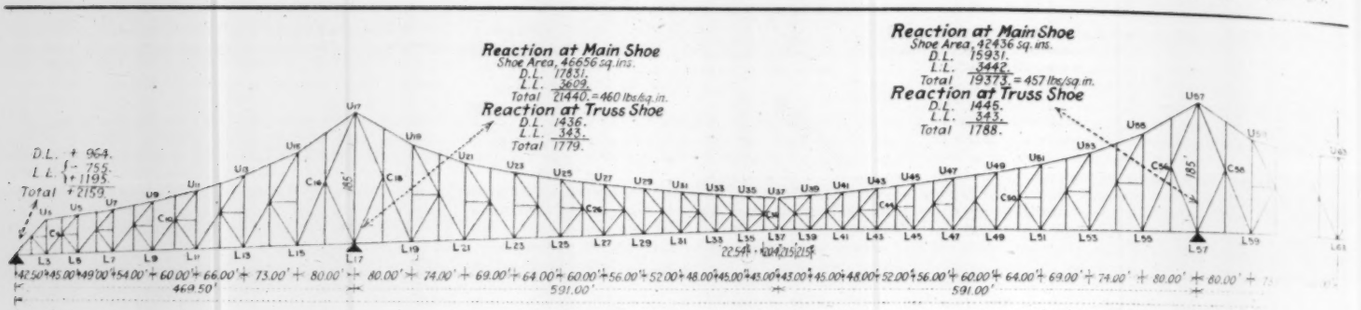
In Lbs. Per Lin. Ft. of Bridge.	
Concrete sub-pavement of roadway	3,200
Wood block sub-pavement of roadway	1,040
Rails and conductor rails for 4 trolley tracks	374
Concrete footwalk slabs	800
6 railings	406
Electric wires, gas mains, etc.	160
	5,980
Less deduction for removing 4 lines of stringers	680
	5,300

or 2,650 lbs. per lin. ft. of each truss, which is a reduction of 1,000 lbs. per lin. ft. each truss from the full assumed dead load.

It will be noted that the concrete footwalk slabs are here taken at 800 lbs. per lin. ft., whereas they were taken at 500 lbs. per lin. ft. in the full dead load; this is due to the fact that in the completed structure they are intended to be 10½ ft. wide, whereas those now temporarily placed on the outer lines of railway stringers are 16 ft. wide. To reach the full reduction required, it will also be noted that we have reduced the allowance for wires and pipes to 160 lbs. per lin. ft. of bridge.

With a live load of 50 lbs. per sq. ft. on the roadway and footwalks, and a live load of 780 lbs. per lin. ft. of each trolley track (which is equivalent to running trolley cars at intervals of 80 ft., c. to c.) we get a total live load of 3,000 lbs. per lin. ft. of each truss, and with this live load in addition to the total assumed dead load reduced by 1,000 lbs. per lin. ft. of truss, we have made the complete stress sheet herewith submitted

(Text continued on page 522.)



Manhattan Anchor Arm | Manhattan Cantilever Arm | Island Cantilever Arm, West | Island

STRESSES UNDER GREATEST PERMISSIBLE LOADING RECOMMENDED BY BOLLER & HODGE.

Stresses in units of 1,000 lbs. per sq. in. + indicates tension. — indicates compression.

COMPUTED FOR THE FOLLOWING LOADS:

LIVE LOAD: *Main Members* computed for

	Pounds per lin. ft. of truss.
11-ft. footwalk, 50 lbs. per sq. ft.	550
2 lines surface street-cars, 780 lbs. per ft. each	1,560
17½-ft. width of roadway, 50 lbs. per sq. ft.	890
Total live load, per foot of truss	3,000 lbs.

This load is to be placed in the positions giving maximum stresses in the individual members.

Sub-Members computed for

On each track a 62,000-lb. street-car having four axles spaced 4 ft. 1 in., 15 ft. 11 ins., 4 ft. 1 in.

On any part of roadway 48,000 lbs. on two axles 10 ft. apart and 5-ft. gage covering a space 12 ft. × 30 ft., and 100 lbs. per sq. ft. on the remaining roadway surface.

On the footwalk a load of 100 lbs. per sq. ft.

WIND LOAD:

Wind pressure 2,000 lbs. per lin. ft. of bridge, all acting in plane of bottom chord. Of this 1,000 lbs. is taken as covering the entire bridge, and 1,000 lbs. is taken as a moving load placed in the positions giving maximum stresses in the individual members.

DEAD LOAD: *Stresses* computed for

Weight of metal as computed from shipping invoices is 105,152,010 lbs. for the whole bridge, or 52,576,005 per truss, distributed according to the actual panel-loads, plus a uniform load of 2,650 lbs. per lin. ft. of truss made up of:

Concrete sub-pavement	1,600 lbs.
Wood block pavement	520 lbs.
Street-car tracks	187 lbs.
Footwalk slab	400 lbs.
Three railings	203 lbs.
Gas mains, mail chutes, trolley wires, telephone cables and their attachments, etc.	80 lbs.
	2,990 lbs.
Less reduction of two elevated railway stringers and bracing included in shipping weight, which must be removed	340 lbs.
Total additional weight per lin. ft. of truss	2,650 lbs.

The stresses in two arms only are reproduced here; the stresses in these arms are with few exceptions greater than those in the other arms. The actual maximum stresses in the several kinds of member throughout the entire bridge, under the above loading are:

BOTTOM CHORD: A *Compression* of 16,800 lbs. per sq. in., in member L65-L67, Island span, cross-section 686.7 sq. ins. gross.

TOP CHORD: A *Tension* of 30,600 lbs. per sq. in., in member U65-U69, Island span, cross-section is 360.0 sq. ins. net. [Nickel-steel eyebars.]

A *Compression* of 6,900 lbs. per sq. in., in member U37-U39, Island Cantilever Arm West, cross-section is 43.0 sq. ins. gross.

MAIN DIAGONALS: A *Tension* of 19,300 lbs. per sq. in., in member C116-L117, Queens Anchor Arm, cross-section 114.7 sq. ins. net. [Carbon-steel eyebars.]

A *Compression* of 10,500 lbs. per sq. in., in member L73-C74, Island Span, cross-section 388.7 sq. ins. gross.

MAIN POSTS: A *Compression* of 17,400 lbs. per sq. in., in member U17-L17 (B) Manhattan Anchor Arm, cross-section at this point 1,211.8 sq. ins. gross.

A *Tension* of 19,800 lbs. per sq. in., in member U59-L59 (T), Island Span, cross-section at this point 236.9 sq. ins. net.

HANGERS: A *Tension* of 15,200 lbs. per sq. in., in member C92-L92, Queens Cantilever Arm, cross-section 31.0 sq. ins. net.

ROCKERS: A *Tension* of 10,900 lbs. per sq. in. and a Compression of 8,300 lbs. per sq. in., in Rocker U37-L37, cross-section 31.2 sq. ins. net and 44.1 sq. ins. gross.

SUB-DIAGONALS: A *Compression* of 11,300 lbs. per sq. in., in member C8-L9, Manhattan Anchor Arm, cross-section 31.1 sq. ins. gross.

A *Tension* of 10,100 lbs. per sq. in., in member U88-C90, Island Cantilever Arm East, cross-section 36.0 sq. ins. net.

SUB-POSTS: A *Compression* of 7,700 lbs. per sq. in. in member U14-C14, Manhattan Anchor Arm, cross-section 15.0 sq. ins. gross.

Island Cantilever Arm, West.

BOTTOM CHORD.

Member	Area sq. ins.	Dead Load.	Live Load.	D.L. + L.L.	Unit Str.	L/R Abt.	Wind Str.
L37-L39	75.0 Gr.	— 15	00 00	— 15	— 0.2	18	± 54
L39-L41	105.0 Gr.	— 621	— 608 + 505	— 1229	—11.7	19	± 187
L41-L43	210.0 Gr.	— 1476	— 917 + 589	— 2393	—11.4	21	± 363
L43-L45	247.6 Gr.	— 2672	—1245 + 603	— 3917	—15.8	22	± 593
L45-L47	355.6 Gr.	— 4227	—1623 + 579	— 5850	—16.4	24	± 888
L47-L49	510.8 Gr.	— 6049	—2026 + 528	— 8075	—15.8	26	±1269
L49-L51	666.8 Gr.	— 8009	—2429 + 406	—10438	—15.7	27	±1903
L51-L53	834.8 Gr.	—10015	—2816 + 410	—12831	—15.4	30	±2727
L53-L55	949.2 Gr.	—11332	—3004 + 351	—14336	—15.1	32	±3776
L55-L56	1040.2 Gr.	—11668	—2947 + 299	—14615	—14.0	34	±4741
L56-L57	1072.1 Gr.	—11668	—2947 + 280	—14615	—13.6	34	±5861

TOP CHORD.

U37-U39	43.0 Gr. 34.4 Nt.	+ 25	— 334 + 294	— 299 + 329	— 6.9 + 9.6	29	
U39-U41	43.0 Gr. 34.4 Nt.	+ 173	— 294 + 297	— 121 + 470	— 2.8 + 13.7	30	
U41-U43	100.0 Gr. 88.0 Nt.	+ 714	— 477 + 608	+ 1322	+ 15.0	40	
U43-U45	94.5 Nt	+ 1585	— 560 + 918	+ 2503	+ 26.5	Nickel Steel Eyebars.	
U45-U47	141.8 Nt.	+ 2810	— 577 + 1255	+ 4065	+ 28.7		
U47-U49	210.0 Nt.	+ 4406	— 552 + 1641	+ 6047	+ 28.8		
U49-U51	290.0 Nt.	+ 6302	— 504 + 2062	+ 8364	+ 28.8		
U51-U53	384.0 Nt.	+ 8385	— 445 + 2494	+ 10879	+ 28.3		
U53-U55	496.0 Nt.	+ 10890	— 417 + 3024	+ 13914	+ 28.1		
U55-U57	612.0 Nt.	+ 13409	— 390 + 3528	+ 16937	+ 27.7		

MAIN DIAGONALS.

U37-C38	57.2 Gr. 45.7 Nt.	— 50	— 416 + 509	— 466 + 459	— 8.1 + 10.0	44
C38-L39	74.6 Gr. 61.0 Nt	— 222	— 420 + 416	— 642 + 194	— 8.6 + 3.2	46
L39-C40	92.5 Gr. 77.4 Nt.	+ 704	— 373 + 530	+ 1234	+ 15.9	56

Island Span.

BOTTOM CHORD.

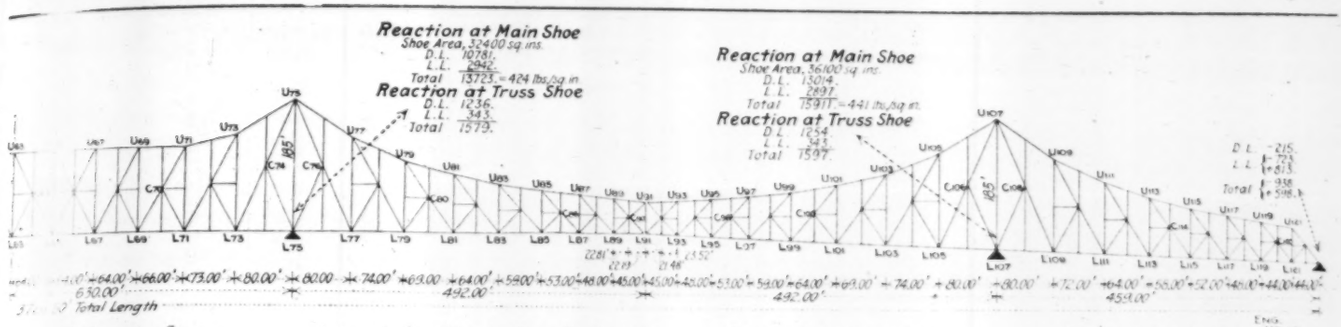
Member.	Area sq. ins.	Dead Load.	Live Load.	D.L. + L.L.	Unit Str.	L/R Abt.	Wind Str.
L57-L58	1066.9 Gr.	—11634	—2963 + 307	—14597	—13.7	31	±5861
L58-L59	1049.9 Gr.	—11634	—2963 + 307	—14597	—13.9	31	±5262
L59-L61	1032.8 Gr.	—12204	—3471 + 452	—15675	—15.2	31	±4869
L61-L63	925.5 Gr.	—11043	—3839 + 893	—14882	—16.1	28	±4551
L63-L65	770.0 Gr.	— 9135	—3721 + 1093	—12856	—16.7	27	±4289
L65-L67	686.7 Gr.	— 7958	—3606 + 1209	—11564	—16.8	27	±4100
L67-L69	651.3 Gr.	— 7346	—3376 + 1129	—10722	—16.4	27	±3979
L69-L71	685.5 Gr.	— 7896	—3257 + 952	—11153	—16.3	28	±3926
L71-L73	717.0 Gr.	— 8042	—2733 + 928	—10775	—15.0	31	±3947
L73-L74	711.2 Gr.	— 7398	—2196 + 335	— 9594	—13.5	34	±4028
L74-L75	711.2 Gr.	— 7398	—2196 + 335	— 9594	—13.5	34	±4258

TOP CHORD.

U57-U59	660.0 Nt.	+ 14597	— 498 + 4093	+ 18690	+ 28.3	Nickel Steel Eyebars.
U59-U61	516.0 Nt.	+ 11509	— 888 + 3942	+ 15451	+ 29.9	
U61-U63	426.0 Nt.	+ 9281	—1093 + 3721	+ 13002	+ 30.5	
U63-U65	384.0 Nt.	+ 8094	—1209 + 3606	+ 11700	+ 30.5	
U65-U69	360.0 Nt.	+ 7508	—1221 + 3491	+ 10999	+ 30.6	
U69-U71	360.0 Nt.	+ 7478	—1129 + 3376	+ 10854	+ 30.2	
U71-U73	392.0 Nt.	+ 8249	— 949 + 3343	+ 11592	+ 29.6	
U73-U75	448.0 Nt.	+ 9662	— 587 + 3222	+ 12884	+ 28.8	

MAIN DIAGONALS.

U57-C58	365.0 Gr.	— 1395	—2131 + 1210	— 3526	— 9.7	94
C58-L59	400.0 Gr.	— 1872	—2131 + 1145	— 4003	—10.0	94
U59-C60	225.3 Nt.	+ 2460	— 899 + 1055	+ 3515	+ 15.6	38
C60-L61	238.7 Gr. 199.5 Nt.	+ 2092	— 902 + 996	+ 3088	+ 15.5	
U61-C62	330.7 Nt.	+ 3950	— 854 + 1565	+ 5515	+ 16.7	



Island Cantilever Arm, West (continued).

MAIN DIAGONALS (Cont.)

Member		Area sq. ins.	Dead Load.	Live Load.	D.L. + L.L.	Unit Str.	L/R Abt.	Wind Str.
C40-U41		84.3 Nt.	+ 842	— 336 + 536	+ 1378	+ 16.3		
L41-C42		105.0 Nt.	+ 1217	— 271 + 586	+ 1803	+ 17.2		
C42-U43		115.5 Nt	+ 1370	— 242 + 599	+ 1969	+ 17.0		
L43-C44		136.5 Nt	+ 1760	— 191 + 649	+ 2409	+ 17.6		
C44-U45		152.2 Nt.	+ 1945	— 173 + 681	+ 2626	+ 17.3		Structural Steel Eyebars.
L45-C46		173.3 Nt.	+ 2342	— 138 + 741	+ 3083	+ 17.8		
C46-U47		189.0 Nt.	+ 2554	— 125 + 782	+ 3336	+ 17.6		
L47-C48		210.0 Nt.	+ 2842	— 86 + 795	+ 3637	+ 17.3		
C48-U49		224.0 Nt.	+ 3084	— 79 + 844	+ 3928	+ 17.5		
L49-C50		228.0 Nt.	+ 3205	— 43 + 804	+ 4009	+ 17.6		
C50-U51		248.0 Nt.	+ 3482	— 39 + 859	+ 4341	+ 17.5		
L51-C52		240.0 Nt.	+ 3454	— 10 + 776	+ 4230	+ 17.6		
C52-U53		280.0 Nt.	+ 3772	— 9 + 837	+ 4609	+ 16.5		
L53-C54		182.0 Nt.	+ 2414	— 236 + 689	+ 3103	+ 17.0		
C54-U55		204.0 Nt.	+ 2763	— 236 + 752	+ 3515	+ 17.2		
L55-C56		106.1 Gr.		— 698	— 270	— 2.5	93	
C56-U57		89.9 Nt. 129.7 Gr. 108.2 Nt.	+ 428	+ 629 — 698 + 695	+ 1057 + 1519	+ 11.8 + 14.0	93	

MAIN POSTS.

U39-L39	T	44.1 Gr.	— 175	— 48	— 223	— 5.1	38
	B	72.9 Gr.	— 219	— 60 00	— 279	— 3.8	
U41-L41	T	74.7 Gr.	— 616	— 370	— 986	—13.2	41
	B	102.7 Gr.	— 664	+ 233 — 379 + 229	— 1043	—10.2	
U43-L43	T	103.0 Gr.	— 1004	— 418 + 169	— 1422	—13.8	42
	B	139.8 Gr.	— 1064	— 429 + 166	— 1493	—10.7	
U45-L45	T	130.4 Gr.	— 1419	— 477 + 121	— 1896	—14.5	46
	B	166.2 Gr.	— 1486	— 490 + 119	— 1976	—11.9	
U47-L47	T	156.2 Gr.	— 1783	— 517 + 77	— 2300	—14.7	48
	B	191.5 Gr.	— 1862	— 532 + 76	— 2394	—12.5	
U49-L49	T	178.6 Gr.	— 2106	— 527 + 38	— 2633	—14.7	54
	B	213.5 Gr.	— 2153	— 544 + 37	— 2697	—12.6	
U51-L51	T	186.4 Gr.	— 2304	— 509 + 9	— 2813	—15.1	51
	B	221.7 Gr.	— 2356	— 527 + 9	— 2883	—13.0	
U53-L53	T	136.2 Gr.	— 1423	— 447 + 208	— 1870	—13.7	59
	B	172.2 Gr.	— 1479	— 467 + 208	— 1946	—11.3	
U55-L55	T	88.5 Gr.	+ 393	— 407	— 14	— 0.2	63
		76.5 Nt.	+ 446	+ 641	+ 1087	+ 14.2	
	B	126.0 Gr.	+ 335 + 393	— 428 + 641	— 93 + 1034	— 0.7	

ROCKER ARM AND HANGERS.

U37-L37	44.1 Gr.		— 376	— 366	— 8.3	64
	31.2 Nt.	+ 10	+ 331	+ 341	+ 10.9	
C38-L38	31.0 Nt.	+ 237	+ 191	+ 428	+ 13.8	
C40-L40			— 10			
C42-L42	31.0 Nt.	+ 166	+ 159	+ 325	+ 10.5	
C44-L44			— 15			
	31.0 Nt.	+ 173	+ 167	+ 340	+ 11.0	
C46-L46			00			
	31.0 Nt.	+ 217	+ 166	+ 383	+ 12.4	
C48-L48			00			
	44.0 Nt.	+ 244	+ 175	+ 419	+ 9.5	
C50-L50	44.0 Nt.	+ 277	+ 184	+ 461	+ 10.5	
C52-L52	44.0 Nt.	+ 315	+ 192	+ 507	+ 11.5	
C54-L54	44.0 Nt.	+ 359	+ 203	+ 562	+ 12.8	
C56-L56	52.0 Nt.	+ 400	+ 213	+ 613	+ 11.8	
	52.0 Nt.	+ 448	+ 223	+ 671	+ 12.9	

Island Span (continued).

MAIN DIAGONALS (Cont.)

Member		Area sq. ins.	Dead Load.	Live Load.	D.L. + L.L.	Unit Str.	L/R Abt.	Wind Str.
C62-L63		304.5 Nt.	+ 3607	— 884 + 1509	+ 5116	+ 16.9		
U63-C64		239.7 Nt.	+ 2496	— 914 + 1398	+ 3894	+ 16.2		
C64-L65		261.9 Gr.		— 921			45	
		218.6 Nt.	+ 2194	+ 1384	+ 3578	+ 16.4		
U65-C66		196.9 Gr.		—1002			40	
		163.7 Nt.	+ 1228	+ 1207	+ 2435	+ 15.2	40	
C66-L67		181.9 Gr.		—1054	— 110	— 0.6	40	
		151.2 Nt.	+ 944	+ 1265	+ 2209	+ 14.6		
L67-C68		211.9 Gr.	— 340	—1215	— 1555	— 7.3	45	
		171.6 Nt.		+ 1113	+ 773	+ 4.5		
C68-U69		177.5 Gr.	— 65	—1172	— 1237	— 7.0	40	
		148.0 Nt.		+ 1124	+ 1059	+ 7.2		
L69-C70		196.9 Gr.		—1141	— 285	— 1.4	35	
		164.2 Nt.	+ 856	+ 1260	+ 2116	+ 12.9		
C70-U71		217.6 Gr.		—1109			35	
		181.3 Nt.	+ 1146	+ 1284	+ 2430	+ 13.4		
L71-C72		211.0 Gr.		—1216	— 1205	— 5.7	38	
		176.4 Nt.	+ 11	+ 948	+ 959	+ 5.4		
C72-U73		187.5 Gr.		—1212	— 875	— 4.7	38	
		157.0 Nt.	+ 337	+ 1006	+ 1343	+ 8.5		
L73-C74		388.7 Gr.	— 2004	—2091	— 4095	—10.5	94	
C74-U75		353.0 Gr.	— 1508	—2091 + 1149 —2091 + 1214	— 3689	—10.4	94	

MAIN POSTS.

U57-L57	T	1250.6 Gr.	—15022	—3459 + 779	—18481	—14.7	54
	B	1036.8 Gr.	—15582	—3459 + 779	—19041	—17.4	54
U59-L59	T	236.9 Nt.	+ 2731	— 881 + 1956	+ 4687	+ 19.8		
	B			— 902 + 1956	+ 4508			
U61-L61	T	163.3 Gr.	— 1092	— 726	— 1818	—11.1	54	
	B	227.3 Gr.	— 1023 — 1141 — 1092	+ 798 — 744 + 797	— 1888	— 8.3		
U63-L63	T	281.0 Gr.	— 2445	—1229 + 803	— 3674	—13.1	62	
	B	343.0 Gr.	— 2494	—1241 + 797	— 3735	—10.9		
U65-L65	T	191.0 Gr.	— 1283 — 1209	—1114 + 880	— 2397	—12.5	57	
	B	254.5 Gr.	— 1331 — 1283	—1124 + 872	— 1455	— 5.7		
U67-L67	T	100.8 Gr.	— 144	00	— 144	— 1.4	54	
	B	165.8 Gr.	— 192	00 — 35 00	— 227	— 1.4		
U69-L69	T	141.8 Gr.	— 128	— 988	— 1116	— 7.9	54	
		121.7 Nt.	— 63	+ 1030	+ 967	+ 7.9		
	B	206.3 Gr.	— 176 — 128	—1000 + 1024	— 1176 + 896	— 5.7		
U71-L71	T	174.2 Gr.	+ 657	— 685	— 28	— 0.2	57	
		148.7 Nt.	+ 730	+ 1075	+ 1805	+ 12.1		
	B	237.7 Gr.	+ 605 + 657	— 703 + 1074	— 98 + 1731	— 0.4		
U73-L73	T B	236.9 Nt.	+ 2769	— 885 + 1919 — 906	+ 4688	+ 19.8		
			+ 2680	+ 1919	+ 4599			
U75-L75	T	919.3 Gr.	—10041	—2957	—12998	—14.2	54	
	B	816.8 Gr.	—10480	+ 1028 —2957 + 1028	—13437	—16.5	54	

HANGERS.

C58-L58	51.0 Nt.	+ 493	+ 223	+ 716	+ 14.0
C60-L60	51.0 Nt.	+ 401	+ 211	+ 612	+ 12.0
C62-L62	43.0 Nt.	+ 349	+ 197	+ 546	+ 12.7
C64-L64	43.0 Nt.	+ 324	+ 192	+ 516	+ 12.0
C66-L66	43.0 Nt.	+ 314	+ 192	+ 506	+ 11.8
C68-L68	43.0 Nt.	+ 310	+ 192	+ 502	+ 11.7
C70-L70	43.0 Nt.	+ 323	+ 197	+ 520	+ 12.1
C72-L72	51.0 Nt.	+ 362	+ 211	+ 573	+ 11.2
C74-L74	51.0 Nt.	+ 411	+ 223	+ 634	+ 12.4

SUB DIAGONALS.

C58-L57	75.0 Gr.	— 477	— 122	— 599	— 8.0	90
C60-L59	53.0 Gr.	— 368	— 120	— 488	— 9.2	30
C62-L61	45.7 Gr.	— 343	— 113	— 456	—10.0	31
C64-L63	42.1 Gr.	— 302	— 109	— 411	— 9.8	31
C66-L65	53.0 Gr.	— 285	— 109	— 394	— 7.4	37
C68-L69	42.1 Gr.	— 275	— 109	— 384	— 9.1	31
C70-L71	45.7 Gr.	— 290	— 113	— 403	— 8.8	31
C72-L73	53.0 Gr.	— 324	— 120	— 444	— 8.4	30
C74-L75	75.0 Gr.	— 406	— 122	— 528	— 7.0	90

Island Cantilever Arm, West (continued).

SUB DIAGONALS.

Member	Area sq. ins.	Dead Load.	Live Load.	D.L. + L.L.	Unit Str.	L/R Abt.	Wind Str.
C38-L37			00				
	21.5 Nt.	+ 24	00	+ 24	+ 1.1		
C38-U39	36.0 Nt.	+ 219	+ 135	+ 354	+ 9.8		
C40-L41	23.0 Gr.	— 134	— 103	— 237	—10.3	39	
			+ 4				
C42-L43	25.7 Gr.	— 152	— 107	— 259	—10.1	43	
			+ 10				
C44-L45	28.4 Gr.	— 185	— 106	— 291	—10.2	48	
C46-L47	31.1 Gr.	— 213	— 111	— 324	—10.4	41	
C48-L49	33.8 Gr.	— 243	— 114	— 357	—10.6	45	
C50-L51	36.4 Gr.	— 278	— 117	— 395	—10.9	50	
C52- 53	42.1 Gr.	— 318	— 120	— 438	—10.4	48	
C54-L55	49.4 Gr.	— 349	— 121	— 470	— 9.5	58	
C56-L57	75.0 Gr.	— 397	— 122	— 519	— 6.9	99	

SUB POSTS.

U38-C38	15.0 Gr.	— 17	.....	— 17	— 1.1	
U40-C40	15.0 Gr.	— 19	.....	— 19	— 1.3	
U42-C42	15.0 Gr.	— 32	.....	— 32	— 2.1	
U44-C44	15.0 Gr.	— 31	.....	— 31	— 2.1	
U46-C46	15.0 Gr.	— 39	.....	— 39	— 2.6	
U48-C48	15.0 Gr.	— 44	.....	— 44	— 2.9	
U50-C50	15.0 Gr.	— 59	.....	— 59	— 3.9	
U52-C52	15.0 Gr.	— 76	.....	— 76	— 5.1	
U54-C54	15.0 Gr.	— 104	.....	— 104	— 6.9	57
U56-C56	21.8 Gr.	— 137	.....	— 137	— 6.3	61

Island Span (continued).

SUB POSTS.

Member	Area sq. ins.	Dead Load.	Live Load.	D.L. + L.L.	Unit Str.	L/R Abt.	Wind Str.
U58-C58	21.8 Gr.	— 151	.....	— 151	— 6.9	69	
U60-C60	15.0 Gr.	— 107	.....	— 107	— 7.1	62	
U62-C62	15.0 Gr.	— 84	.....	— 84	— 5.6		
U64-C64	15.0 Gr.	— 75	.....	— 75	— 5.0		
U66-C66	15.0 Gr.	— 71	.....	— 71	— 4.7		
U68-C68	15.0 Gr.	— 71	.....	— 71	— 4.7		
U70-C70	15.0 Gr.	— 73	.....	— 73	— 4.9		
U72-C72	15.0 Gr.	— 88	.....	— 88	— 5.9	62	
U74-C74	21.8 Gr.	— 107	.....	— 107	— 4.9	69	

(Sheet No. 7) [a typical portion of this stress-sheet is reproduced in the table herewith—Ed.] and it will be seen that all these stresses come practically within the limits of safety set by us, and the bridge is in our opinion safe for these loads.

It will be noted that the dead load stresses shown on this stress sheet are computed with the full weight of structural material shown on our sheets 1, 2, and 3, but the total dead panel loads shown on our sheets 1 to 6, inclusive, were reduced for computing these dead load stresses by a uniform deduction of 1,000 lbs. per lin. ft. of truss as above itemized.

POSSIBLE FURTHER REDUCTION OF WEIGHT TO PERMIT TWO ELEVATED TRACKS.

The dead load of the floor systems can be further reduced if necessary, and we are of the opinion that by reducing the dead loads on all the lever arms, and perhaps increasing the dead loads on the Island span and anchor arms, the structure can be made to safely carry one pair of elevated tracks.

In our opinion the most practical method of getting this bridge into prompt service is to remove the stringers from the two inside lines of upper railway tracks, and open the bridge for service of the highway, sidewalks and four trolley tracks immediately.

If at some future time it is found necessary to make use of one pair of elevated tracks, further modifications of the dead loads can be made and the outer lines of elevated railway stringers used for their true purpose; the sidewalks being removed to their final position outside the trusses.

We therefore make the following

RECOMMENDATIONS:

First—That the stringers of the two inside tracks on the upper decks, or other equivalent dead load, be removed to lighten the dead load.

Second—That the trolley traffic be so regulated that if four tracks are in use the cars shall not run with clear intervals between them of less than their own length.

Third—That the bridge be opened for the traffic of the sidewalks, highway and four lines of trolley tracks as at present constructed, subject to the above recommendations.

Fourth—That if any other moving loads be added to the structure, such further modifications of the dead load shall first be made as will keep the total direct stresses caused by the live and dead loads within the safe limits herein set.

Under these recommendations we are confident the structure is perfectly safe.

Respectfully submitted,

Boller & Hodge,
Consulting Engineers.

October 28, 1908.

Accompanied by one appendix and ten drawings, as follows:

1. Detailed dead panel loads, Manhattan Anchor and Lever Arm.
2. Detailed dead panel loads, Island Span and Lever Arms.
3. Detailed dead panel loads, Queens Anchor and Lever Arm.
4. Dead panel loads and points of application, Manhattan Anchor and Lever Arms.
5. Dead panel loads and points of application, Island Span and Lever Arms.
6. Dead panel loads and points of application, Queens Anchor and Lever Arms.
7. General stress sheet of main trusses.
8. Section of truss members, Manhattan and Queens Anchor and Lever Arms.
9. Sections of truss members, Island Span and Lever Arms.
10. Erection stress sheet.

Report of Wm. H. Burr.

Hon. J. W. Stevenson,
Commissioner of Bridges,
City of New York:

Dear Sir.—Pursuant to action of the Board of Estimate and Apportionment, you instructed me, under date of June 9, 1908, "to examine and report upon the design and structure of the Blackwell's Island Bridge." Since that date I have been continuously prosecuting the work covered by your instructions and I respectfully submit this as my report.

I understand your instructions as to this examination to be sufficiently broad to include the general questions of safety and stability irrespective of the provisions of the specifications; in other words, that this examination is not to be limited by those provisions.

On taking up these duties I found that a part of the engineering staff of the Department of Bridges had for some time been engaged on a recomputation of the stresses of the Blackwell's Island Bridge; but in order that the duties prescribed to me might be completed as an independent and homogeneous whole, a complete analysis of the stresses in the Blackwell's Island type of bridge structure was made as set forth in Appendix I., in accordance with which an independent set of computations of stresses for the entire structure was begun and carried to completion. The results of the computations on which the conclusions of this report are based are given on sheets 1, 2, 3, 4, 5 and 6, appended hereto.

[Here follow the dimensions of the bridge, as given in Fig. 1, and a statement of the specified quality of material, specified loads and specified stresses, substantially as already given in the report of Boller & Hodge, though Prof. Burr also quotes the bending tests and other specifications for material, not mentioned by them. Prof. Burr's report continues:]

The remaining provisions of the specifications need not be quoted for the purposes of this report, but they are reasonably full and comprehensive and well calculated to accomplish the ends desired.

The transverse bracing of this bridge is designed to transfer all wind load against the upper part of the structure to the lower chord. All wind truss stresses will therefore be found in the plane or surface of the latter.

These specifications were prepared for the design of a bridge structure of unusual magnitude, the greatest length of span being 1,200 ft., and the volume of traffic to be accommodated is of extraordinary proportions. Fig. 1 shows a skeleton elevation of the entire structure between the Manhattan and Queens Borough anchorages. Fig. 2, on the other hand, shows a typical cross-section of the bridge as contemplated under the specifications. The bridge has two decks or traffic carrying platforms, one along the lower chord accommodating four trolley railway tracks, two outside of the trusses and two inside adjacent to those trusses, with a 35.5-ft. roadway between the latter. The upper deck was intended under the specifications to accommodate four lines of elevated railway track between the trusses and two sidewalks, each 11 ft. wide, supported on cantilever brackets outside of the trusses.

As there are no elevated railway connections at the Queens Borough end of the bridge and no immediate prospect of such connections, the bridge will not be required to carry any elevated railway traffic for some indefinite period after its completion. Further, it is still more uncertain when the growth of traffic which this bridge must accommodate will require the use of four railway tracks on the upper deck. It was therefore decided to place in position the stringers only for those tracks for the present and to use the pair assigned to each truss to support the sidewalk, and thus leave the overhanging cantilever construction of the lower outside of the trusses, until the bridge should be required to carry full elevated railway traffic. The condition under which the bridge would be completed, therefore, is shown by the typical cross-section, Fig. 3.

THE ALLOWED STRESSES.

Proper provision for various classes of loading for a structure of such magnitude, designed to carry an extraordinary volume of traffic, with the corresponding working stresses, is largely a matter of judgment. This broad question was given much consideration by a Commission of Bridge Experts,* appointed to examine and pass upon the plans for the Manhattan Bridge, under date of March 9, 1903. The Manhattan Bridge was planned for the same total traffic capacity as that of the Blackwell's Island Bridge, and that Commission recommended the same "congested" and "regular" loads of 16,000 lbs. and 8,000 lbs. per lin. ft. of bridge as prescribed for the Blackwell's Island Bridge. That Commission, consisting of Messrs. George S. Morison, C. C. Schneider, Mansfield Merriman, Henry W. Hodge and Theodore Cooper, stated, however, that the "congested" load "is a possible load which could never occur unless special pains were taken to produce it." With such an improbable but possible load, the working stresses may properly be taken substantially higher than for a "regular" load, which, while not likely to exist frequently, is far more likely to occur than the "congested." This Commission of Bridge Experts made no recommendation as to working stresses for the "congested" load, but stated

that the bridge should be so proportioned that with the "congested" load of 16,000 lbs. per lin. ft., covering the whole bridge, combined with dead load and wind pressure, no stresses would be produced anywhere reaching the elastic limit of the material. * * * In other words, it should not be possible for such an extraordinary "congested" load to do any permanent injury to the bridge.

Inasmuch as actual tests of full size annealed eyebars of both ordinary structural and nickel-steel have shown that the elastic limits of those members may be safely taken at about 28,000 lbs. per sq. in. and 48,000 lbs. per sq. in., respectively, it will be found that the prescribed working stresses under the congested live load in *the specifications* of the Blackwell's Island Bridge lie within the prescribed limits set forth by the Commission of Bridge Experts named above. In fact, it appears from the latest tests of full size carbon structural steel and nickel-steel columns that the greatest prescribed working stresses for the compression members of the Blackwell's Island Bridge lie sensibly below those limits. It appears from a careful reading of the report of this Commission in connection with the specifications for the Blackwell's Island Bridge that the latter were modelled closely upon the lines laid down in the report of the Commission of Bridge Experts so far as they were applicable to the Blackwell's Island structure.

While therefore the specified loads and working stresses for the Blackwell's Island Bridge are to be considered as safe and satisfactory in the light of knowledge and precedent available when they were drawn, it is my judgment that the experience which has accrued in connection with the actual construction of long span bridge structures within the intervening five years is such as to require some modification of the high working stresses then thought permissible. I cannot concur in the opinion of the Commission of Bridge Experts, that a possible combination of loads should be permitted to produce stresses just under the elastic limit. Whatever may have been considered permissible then, it is my judgment that the loading should be so modified now as to produce maximum stresses sensibly lower than that limit. It would be prudent to limit the greatest possible stresses produced by the "congested," dead and wind loads to three-fourths of the elastic limit.

In view of the increasing concentrated loads of nearly

*Their report is given in Eng. News, March 12, 1903, p. 243. A supplementary report appears in Eng. News, July 2, 1903, p. 24.

all kinds of traffic passing over such a structure as the Blackwell's Island Bridge, it is my judgment that the working tensile stress in subverticals or hangers could judiciously be limited to 15,000 lbs. per sq. in. instead of 18,000 lbs. per sq. in. although the use of the latter value does not prejudice the safety or durability of the structure. Such members, however, are subject to shock and greater concentrated loads than may be contemplated and a wide margin of safety is advisable for stresses as produced.

THE PHYSICAL CONDITION OF THE BRIDGE.

The provisions of the specifications both for the chemical and physical requirements of the material are in accordance with the best practice of the present day and entirely satisfactory. I have as far as possible examined the matter of inspection both in the mill and shop, and I have scrutinized carefully a mass of records of experimental data established by tests of both specimens and full-size eyebars in the course of mill inspection with satisfactory results. All of this class of evidence goes to show that the material put into the bridge was of excellent quality and fully [met] the requirements of the specifications.

The character of shop work is evidenced by the condition of the manufactured members in the bridge. These are largely open to ocular inspection, and I have many times been on the structure for the purpose of examining the results of the shop work. I believe it to be fully up to the requirements of the specifications and generally in accordance with the best practice of the present time. The four sub-diagonal posts C56-L57 and L107-C108 on both trusses near the main piers on Blackwell's Island were a little twisted when put in place, but this difficulty was corrected by riveting cover plates on the tops of the posts. These posts are not main truss members and the question of the safety or stability of the latter is in no way affected by them.

Many sections have been carefully calipered and the weights of many members have been computed in order to determine whether the actual dimensions of pieces as placed in the structure correspond to the requirements of the specifications, contract and shop plans. The results of these examinations have been entirely satisfactory. The actual sections of the members are generally found a little full, a margin of 2½% being allowed by specifications in accordance with common practice. The total steel in the structure as built and as determined by the actual shipping lists and scale weights confirmed by the computations mentioned above is shown by the following detailed statement:

ERECTED STEEL WEIGHT.

Manhattan Anchor Span	14,501,190 lbs.
Manhattan Tower	3,705,550 lbs.
Manhattan Cantilever Arm	13,246,690 lbs.
Island Cantilever, West	12,934,040 lbs.
Island Span	21,167,080 lbs.
Island Towers	6,188,830 lbs.
Island Cantilever, East	9,370,900 lbs.
Queens Cantilever Arm	9,351,960 lbs.
Queens Anchor Arm	11,592,770 lbs.
Queens Tower	3,074,800 lbs.
Total	105,133,780 lbs.

I have made a careful examination of the entire structure as far as possible, with a view of determining whether evidence of distress of any members exist, such as permanent distortion, loose rivets, or other evidences of overloading, misfitting or any other circumstance which might indicate over-stressing. I have not found such evidence. All parts of the structure appear to be in satisfactory condition. There are minor or small variations from alignment which are usually observed in large completed bridge work in place, but nothing whatever to indicate any inherent weakness or unsatisfactory condition.

In addition to this inspection, I have had accurate surveys made of the entire structure to determine the alinement of trusses and elevation of lower chord points in July and as late as October 26, the past month. These surveys indicate that the alinement of the trusses is entirely satisfactory, and that the deflections vertically are only those caused by the dead weight of the structure at the two dates stated, the dead weight at the latter date being considerably more than at the former in consequence of the large amount of floor material put in place within the period named.

THE FLOOR MEMBERS.

The computations for the stringers and floorbeams for both upper and lower decks show that, in the main, the prescribed unit stresses are not exceeded. In a large number, perhaps the majority of cases, the computed stresses are considerably below the specified limits. In a few cases of the lower floor beams and trolley stringers, the specified unit stresses are to a small extent exceeded. This excess is due to the use of less dead load than the weight of the floor as finally constructed. This excess, however, is too small to be material.

The outside trolley stringers on the lower floor of the Island span and its cantilever arms have been built in accordance with the specifications, but while they were being completed, it was thought that the heavier subway cars might at some future time run over these tracks. Consequently, the outside trolley stringers on the remainder of the bridge were cover-plated to meet the requirements of the increased loading. If, in the future, the heavier subway cars should be run over the structure, it would be necessary, as was intended, to put these cover plates on the stringers of the Island span and its cantilever arms, which may be readily done if it should ever be required.

THE FOUNDATIONS.

An examination of the design and construction of the anchorages at both ends of the structure shows that weights of masonry and other portions of the anchorage and its members are sufficient and satisfactory for their purposes. The pressures on the masonry in the main piers are also within the requirements of the specifications.

THE ERECTION STRESSES.

The erection stresses are now of secondary importance, if of any importance at all, as the structure is erected and the erection stresses have passed never to recur. These stresses, however, have been computed with the weight of the traveller taken at 647 tons distributed as in actual use. Two such travellers have been assumed to be in use simultaneously on the east and west cantilever arms of the Island span and in positions to produce the greatest stresses. The results of these computations show that the erection stresses in the chords could not at any stage of the construction equal those due to the completed dead weight of the structure. In a few of the diagonals in the vicinity of the main piers, the erection stresses equal those produced by the specified dead and live load. Inasmuch as these stresses exist in the structure but once and will never exist again, they have no special significance in regard to the carrying capacity of the bridge, nor has the weight of the traveller been a test of the structure comparable with the traffic loading which must be carried.

SNOW LOADS.

It is to be observed that the specifications do not call for any snow loading. In view of the fact that there are occasionally heavy snowfalls at New York, sometimes followed by rain and subsequent freezing, it would seem to have been advisable to make some suitable provision for this class of loading. At the same time, if the usual street-cleaning removal of snow from the bridge is promptly made, it is clear that there is practically no possibility of snow load and even the regular live load concurring. The administration of this structure should, therefore, be stringently carried out to meet that requirement, otherwise an objectionable overloading is possible.

It is assumed throughout this investigation that the adjustment of the supports at the ends of the anchor arms is such that the rocker arms are subjected to no stress when the bridge is free of live load. The determination of all stresses requires that condition to be assured after the completion of the bridge.

STRESSES FOR SPECIFIED LOADING.

I have had computed a complete stress sheet for the greatest possible stresses in every part or member of the entire structure using the prescribed "congested" moving load and wind loading and the actual dead weight of the structure as determined by the shipping weight of all the steel and other metal members, and by the working plans for the railways, roadways and sidewalks of the upper and lower decks. The dead weight of the structure thus determined is composed of the items per linear foot of bridge shown in detail on the stress sheets.

The results of these computations show that *there are a considerable number of the main truss members which would be overstressed under the provisions of the specifications for the assumed loading.* Some of the bottom chord panels of the Island span would carry about 25% more than permitted by the specifications for compression under dead and congested live loads. The bottom chords of some other portions of the bridge would be overstressed under the same conditions up to a maximum of about 15%.

Under the conditions for which this structure is designed, as already stated, the top chord and main truss members other than those of the bottom chord are not affected by the wind.

With the same conditions of loading as above, the nickel-steel eyebars in the top chords of the Island span would be overstressed about 25% as a maximum, and 20% in the top chord of the Queens cantilever arm, while the maximum overstress in the Manhattan cantilever arm and the two Island cantilever arms would be 15% to 20%. The overstresses in a number of the carbon steel eyebars would range from 10 to 15% in some members in all parts of the structure except in the Queens anchor arm where 30% is reached in one case. There would be also some similar overstresses in riveted tension members in the same parts of the bridge, rising above 33% in a single instance. Few main posts in all the bridge would be overstressed as much as 25%. In the Queens anchor arm there is one post which would be overstressed 33%. The Manhattan rocker arm would be overstressed nearly 20% in tension and 30% in compression, while the Queens rocker arm would be subjected to an excess of 10% in tension and 12% in compression.

Among the secondary or sub-truss members, one hanger near the center of the Manhattan cantilever span would be overstressed about 20% and another about 10%. All other hangers, sub-diagonals and sub-posts would receive practically their proper stresses only.

These greatest overstresses, running with two or three exceptions not above a maximum of 25% of the stresses permitted under the specifications, would not be serious if the permitted working stresses were not initially high. In fact, there are bridges in use and considered safe in which similar overstresses exist although such conditions can never be considered satisfactory. Again, as none of these excessive stresses per square inch of cross-section, even when combined with wind load stresses, exceed some of the elastic limits determined by experiment for the corresponding members in which they are found, those stresses exceed but little, if any, the limits permitted for the stresses due to the congested live, dead and wind loads of the Commission of Bridge Experts whose report has already been alluded to. In my judgment, however, as already expressed, the maximum stresses permitted in that report, under the congested, dead and wind loads, are too high, and it is further my judgment that these computations show that *sufficient provision was not made in designing the cross-sections of the members of the Blackwell's Island Bridge for the two additional elevated tracks which were added to the structure in* 1904.

It becomes necessary, therefore, to ascertain what is the safe maximum loading of this bridge for both the lower deck and the upper deck, including in the latter such elevated railway tracks as may be permissible. For this purpose it is considered prudent to adopt for the greatest permissible working stresses those prescribed in the specification "For Dead Load and Regular Live Load or for Dead Load and Wind," except that for reasons given later on the working stress for columns will be taken at 20,000-50 l/r.

REDUCTION OF DEAD LOAD.

Substantial advantage may be gained for the structure by removing some portions of the dead load of the floors both for the upper and lower decks. An examination of the plans shows that considerable concrete under the two inside trolley tracks of the lower deck as well as some other floor details may be either omitted or modified without in any way trenching upon the capacity, solidity or strength of the lower floor. Similarly, if the two upper elevated railway tracks, including the supporting stringers added in 1904, be removed, and if the sidewalk railings of the upper deck be rearranged without affecting their capacity or strength, the dead weight of the structure may be reduced at least 1,272 lbs. per lin. ft. of each truss on all the cantilever arms. It is conducive to relieving the maximum stresses to permit the weight of the lower deck to remain unchanged on the Island span and the two anchor arms. The relief of dead weight on those three parts of the bridge would then be but 380 lbs. per lin. ft. of truss.

SAFE MAXIMUM LOAD.

In considering the maximum loading to be taken in a re-computation of stresses, it should be observed that the conditions which will produce a congested load in one direction on this or any similar great bridge will be likely to stop traffic largely or entirely in the other direction, as has frequently been observed in treatments of this question of congested loading for great bridge structures. For this reason, it is believed that 50 lbs. per sq. ft. of roadway and sidewalk is sufficient for an assumed congested load for the main truss members of the Blackwell's Island Bridge, that loading to cover any or all parts of the structure necessary to give any member its greatest possible stress.

The heaviest trolley car now running in the city with its full load weighs 62,000 lbs. on four axles, and has an out to out length of 42.5 ft., thus producing an average load of 1,460 lbs. per lin. ft. of each track. The heaviest motor car running on either elevated or subway track when fully loaded has a weight on each of two axles of 30,800 lbs. and 22,200 lbs. on each of the other two. As this car has an out to out length of 51 ft., its average weight is 2,080 lbs. per lin. ft. of track. The heaviest trailer car now running in the city and fully loaded has a weight of 70,000 lbs., with a total length of 51.4 ft., making an average load of 1,360 lbs. per lin. ft. of track. An eight-car train composed of five motor cars and three trailers giving an average weight of 1,810 lbs. per lin. ft. of track will be taken for the moving load on two elevated railway tracks of the upper deck.

All dense trolley or elevated railway traffic on the East River bridges of this city must be effectively controlled by proper signals and continuous inspection, as experience has demonstrated on the Brooklyn and Williamsburg bridges. In computing the stresses in the main truss members of the Blackwell's Island Bridge the same control of the trolley traffic will be assumed as that exercised on the Brooklyn Bridge and on the Williamsburg Bridge, two succeeding trolley cars being separated by a clear space of about two car lengths. Similarly, the

control of the traffic on the two elevated tracks would be secured by making the minimum distance between the heads of trains 1,000 ft. as is now done on the Brooklyn Bridge. The maximum stresses produced in the trusses of the Blackwell's Island Bridge, however, are found by placing one 8-car train with an average of 1,180 lbs. per lin. ft. of track at the center of each of the Manhattan and Queensboro cantilever spans, making the heads of trains about 1,722 ft. Any other arrangement of trains with a distance from center to center not less than 1,000 ft. will produce less stresses in the truss members than that just described.

This total moving load representing the maximum permissible traffic for the Blackwell's Island Bridge, arranged with two elevated railway tracks and constituting what may be called a congested live load will be as follows:

PERMISSIBLE LOADING.

	Lbs. per lin. ft. bridge.
2 Elevated 8-car trains, at 1,800 lbs....	3,620
4 Trolley tracks, ½ by 4 by 1,460 lbs....	1,947
35.5 ft. roadway, at 50 lbs. per sq. ft...	1,775
22 ft. sidewalk, at 50 lbs. per sq. ft....	1,100
	8.442

. This total load of 8,442 lbs. is for each linear foot of bridge covered simultaneously by the four classes of traffic, each truss carrying one-half of this total.

The stress computed for all the main truss members are shown on sheet No. 3. The positions of trains required to produce these greatest stresses are shown on sheets Nos. 4 and 5.

Comparing results with the specified permissible unit stresses given on page 52 of the specifications and reproduced in the earlier part of this report for dead load and regular live load, excepting those for columns already alluded to, this stress sheet shows that no unit compressive stress in all the trusses exceeds the prescribed working limit. Nor is there but one instance where nickel-steel eyebars show stresses as much as 4%, or, but three instances as much as 3½% above prescribed value. Similarly, but one carbon steel tension member shows 4½% overstress. These overstresses are too small to be of moment and they may be ignored.

It has been shown by actual computations, therefore, that the Blackwell's Island Bridge has a safe and satisfactory capacity for carrying a volume of traffic under the conditions of control found advisable by experience on the Brooklyn and Williamsburgh bridges, sufficient for a considerable future period and perhaps for a long future period. No elevated traffic can pass the structure for some time to come as there are no connections for such traffic at the Queensboro end of the bridge. Whenever such traffic may be required, the two elevated tracks on the upper deck will serve that purpose. The question of further accommodation for lines of traffic on the upper deck may judiciously be left for later consideration when demanded by future requirements and when the character of traffic to be accommodated at that time shall become known. It is only necessary so to adjust the accommodations for such future developments as will keep the unit stresses in the main truss members within the limits prescribed in the specifications for regular live and dead loads or for those loads combined with the wind loading.

The formula given in the specifications for the safe carrying capacity of columns or posts of carbon structural steel members is 20,000 — 90 l/r lbs. per sq. in. Recent tests of full size members of this class indicate clearly that this formula gives results lower than need be taken for this class of members, and hence, in computing the proper working stresses for the structural steel members of this bridge, the value 20,000 — 50 l/r has been used. The ultimate carrying capacity, which is practically the elastic limit, of such columns with a ratio of length over radius of gyration of 40 to 50 is not less than 31,000 to 32,000 lbs. per sq. in., nor less than 28,000 to 29,000 lbs. per sq. in. for a ratio of length over radius of gyration of 90.

TESTS OF COMPRESSION MEMBERS RECOMMENDED.

I recommend that the Department of Bridges have made and tested to destruction not less than six pairs of structural steel compression members, each pair being duplicates, similar in cross-section to the typical compression members in the chords and web members of this bridge, the areas of cross-section of such columns to be the greatest capable of being tested in the testing machines of the largest capacity in this country, such test columns to have pin heads. Such tests could be made within a comparatively short time; and if the test columns are judiciously designed with a range of length over radius of gyration varying from 40 to 100, valuable and accurate information as to the safe carrying capacity of such members would be disclosed. It is not necessary, however desirable it might be, to test columns of the greatest area of cross-section in the trusses, which are far beyond the maximum capacity of any testing machine now available.

Approximate computations only have been made for the secondary stresses due to the distortion of the trusses by the live load, and by the variation of temperature. Although such computations may readily be made, it is a matter of grave doubt whether these stresses ever exist to the extent indicated by computations. When secondary stresses are computed at truss joints, it is essentially impossible to make due allowance for the presence of the heavy joint plates and other details which greatly reduce the stresses computed for the sections of the members themselves. As a matter of fact, observations on wrecked trusses show that in well designed work the joints at which the secondary stresses are supposed to be greatest are the parts frequently showing the least distress and the greatest rigidity or the least departure from their normal condition. The approximate computations made for these secondary stresses in a considerable number of truss members show that the computed intensities are below 3,000 to 3,500 lbs. per sq. in. As these maximum intensities exist in extreme fibers only and probably not to the extent shown by the computations, it is clear that they can have no material effect upon the safety or stability of the truss members.

The stresses arising from the bending of horizontal or inclined truss members due to their own weight are of a much more definite character. Computations of these own weight bending stresses have been made on a large number of truss members and they may in some cases run as high as 3,000 lbs. per sq. in. to possibly 4,000 lbs. per sq. in., although generally of lower value than the former. Again as these are extreme fiber stresses only and for short parts of the members in question, they may be disregarded as having no material effect upon the proper safe or working value of the members in question.

There are also some stresses which may be called secondary which are due to the acceleration and retardation of moving trains upon the elevated railway tracks which are supported midway of the vertical web members, but they are of such uncertain values, scarcely subject to even approximate computation, that they may be legitimately considered as incidental stresses covered by the margin allowed in determining proper working stresses.

The wind stresses shown on the stress sheet, Sheet No. 3 are compiled from the prescribed wind loads and in the manner prescribed by the specifications. It will be observed that chord stresses only are given as the design of the bridge trusses with their transverse bracing is such that all wind loads are carried down to the lower deck over which a rigid buckle plate floor is found. This buckle plate floor and the lower chords constitute to a material extent a great plate girder to resist the horizontal wind forces. No web stresses are therefore to be determined. As a matter of fact it is a question whether even the full computed chord wind stresses can exist.

THE BOTTOM CHORDS.

Adverse comment has been made on the heavy compression lower chords of this bridge and their design therefore has been scrutinized with great care. Each chord is composed of two parallel and independent, built-up channel compression members connected together with top and bottom 15-in. by ½-in. batten or tie plates. Each member of this pair of compression chords is composed of two built-up channels with vertical web plates 48 ins. deep and of varying thicknesses to afford the proper area of section, each web having 8-in. by 6-in. angles top and bottom. Each of these pairs of built-up channels is latticed, top and bottom, with a double system of 5-in. by ⅝-in. lacing bars held by two rivets at each end and one at each of the intersections. The entire chord composed of each of these two units has therefore a total width of about 82 ins.

The radius of gyration of each of these chord units about its horizontal neutral axis is about 14 ins., while the radius of the same section about its vertical neutral axis is about 12 ins. The numerous top and bottom batten or tie plates certainly give material horizontal stiffness to the two units although not as much as would heavy lattice bracing. It is reasonable and safe to give the horizontal radius of gyration of this double column section a value of 14 ins., identical with that of its vertical radius, and this has been done in the computations. It will be found by examination of the stress sheet that there are other compression members of the trusses which sustain higher unit stresses with a greater ratio of length over radius of gyration. There can be no apprehension, therefore, that these lower chord compression members are in any way unsafe or of less unit carrying capacity than other main compression members of the trusses.

No criticism of these lower chord compression members would probably have been made except for the failure of chord sections of somewhat similar general shape of section in the Quebec Bridge. The similarity, however, lies only in the general form of section of the component parts. The spacing details of the Blackwell's Island chord sections, consisting of heavy lattice bars, batten and tie plates, and transverse diaphragms, are relatively far heavier, stiffer and stronger than corresponding details in the Quebec trusses; indeed, in the latter, there were no transverse diaph[ragms] such as are found in the Blackwell's Island Bri[dge] there is therefore little or no similarity as to the [ ] carrying capacity of the compression chord member[s] the two bridges. The deflections of the extremities [of] cantilever arms under the moving load shown [on] stress sheet accompanying this report may be as[sumed] as 2 inches. In computing this deflection the [ ] section of riveted tension members has been used, [a] modulus of elasticity for both carbon and ni[ckel] steel of 28,000,000 lbs. per sq. in. This deflection [ ] the loss if the depth of trusses were greater. Subst[antial] economy would have been attained if the truss[es] been designed with a greater depth and with long[er] chords in the main truss system, at the same time gai[ning] greater stiffness.

The lateral stiffness of a cantilever str[ucture] especially of this magnitude, is of much import[ance] and it is affected greatly by the horizontal wi[dth] between trusses which in the present instance is 60 [ft.] A comparison of the length of the Manhattan ca[ntilever] arm, 591 ft., with this 60-ft. width between truss[es] that the latter dimension has been judiciously ch[osen] giving to the structure a proper lateral stiffness, [especially in] connection with the buckle plate floor.

CONCLUSIONS.

First—The specifications for the chemical [and] physical requirements of both the nickel and carbon [steels em]ployed in the structure are satisfactory and [in] accord with the best practice of the present time.

Second—Both the shop and mill inspection [were] efficiently performed, resulting in securing excellent quality of material and the fabrication of truss [members] of good quality and accurate dimensions.

Third—The various members of the structure possess the full sections required by the unit stresses and the working plans, and the shipping weights corresponded correctly to those sections as well as to the computed weights.

Fourth—The erection was successfully and satisfactorily performed, leaving the trusses in correct alinement and elevation.

Fifth—Computations in accordance with the specifications for the maximum floor loads show that the capacities of the floors for both the upper and lower decks are satisfactory.

Sixth—Computations for all the main truss members of the bridge show that the stresses produced by the prescribed congested live load, combined with the dead load or with the dead load and wind loading are higher than prescribed as permissible in the specifications, and higher than prudent to permit, although practically not in excess of the limits approved by the Commission of Expert Engineers in 1903.

Seventh—The stresses disclosed by the stress sheet submitted with this report show that a controlled traffic on the four trolley lines of the lower deck and on two elevated railways of the upper deck carrying the heaviest cars of their classes now in use in the City of New York together with a vehicular traffic on the roadway and two loaded sidewalks may be permitted without exceeding the specified unit stresses for the regular live load and dead load and without exceeding the safe limits of stresses for such a structure, provided the re-arrangement of the floor of the lower deck and the removal of the two elevated railway tracks on the upper deck together with the rearrangement of the sidewalk details be made as indicated in this report so as to reduce the dead load by at least 1,172 lbs. per lin. ft. of each truss of the cantilever arms and 380 lbs. per lin. ft. of each truss of the island span and anchor arms. This rearrangement and reduction of dead load can now be made without material delay in the opening of the bridge for traffic. The capacity so afforded is satisfactory and sufficient for a considerable future period. Any further use of the upper deck for elevated railway or other purposes should be deferred until the development of traffic in the future may make it necessary, and until it shall be determined what character of traffic must then be accommodated, but that adjustment to the future traffic should not be such as to produce greater unit stresses than those approved in this report.

Eighth—The distance between trusses is suitable to this type of structure and such as to secure satisfactory lateral stability, especially in connection with the buckle plate floor.

Respectfully submitted,

Wm. H. Burr,
Consulting Engineer.

Broadway and 117th St., New York, N. Y., Nov. 4, 1908.

AN INDUSTRIAL SCHOOL was opened at Lawrence, Mass., on Oct. 19, with about 900 students. There are both day and evening courses with free tuition and no entrance examinations. All students must be shop or mill operatives. The character of the instruction is along the lines of regular technical schools, but of course is given in a much more elementary form. The director is Mr. W. H. Dooley.

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A correspondent sends us an article on "liberal education" setting forth the deficiencies of the old time courses of instruction in the classics on the one hand and of the courses in technical schools on the other. In an accompanying personal letter he writes:

> You doubtless agree with me that the greatest qualification for success is, as I state in the article, a general broad knowledge of things and men, combined with a keen perception, ready analysis and quick application.
> At present this is considered a matter of purely personal equation and natural talent, but I can see no reason why it is not possible by education to assist the natural abilities along this line as well as it has been shown can be done along other lines.
> Why can not a Chair of "Horse Sense" and "Character Analysis" be established in our colleges as well as the multitude of Chairs which have weak bottoms and weaker legs?

Our correspondent lays down "the greatest qualification for success;" but we venture to amend his definition as "qualification for the greatest success."

It is true that there is an urgent demand for men with large executive ability; but what is the reason for this demand? Is it not because nature is very sparing in her production of this class of men? The fact is that executive talent commands a high market price, not because there is a large demand for it, but because the supply is so small. Actually it takes only a few General Managers and Department Heads to conduct a great business; just a few Generals only are required in an army.

We agree with our correspondent that there is need for a system of liberal education formed on broader lines than those now accepted in our universities. But such an education can hardly be planned as a training for executive work merely, else there will be danger that it will prove only one more course for specialists.

As to formally teaching in any institution "horse sense," judgment of men, initiative and other qualities which make up the successful executive, we do not believe any school or university can create such elements of character, in its students, desirable though they may be. The utmost the institution and the instructors could do—even under ideal conditions—is to cultivate the natural powers already existent.

It is very common at the present day to meet every new trouble in the body politic with the suggestion that the remedy for the trouble ought to be taught in the schools. As a result of this mistaken idea we have our schools teaching all sorts of things—from prohibition to uniform accounting and from good roads to municipal ownership—to the real detriment of our educational system.

That the future will see a very extensive application of electric motive-power to "steam" railways, or perhaps we should say to main-line railways, is a patent fact. But for the present, and in the immediate future, we must still rely on the steam locomotive. Most engineers will agree, no doubt, that it will be a good many years before electric railway operation has displaced even one-third of the present number of steam locomotives. In the meantime we must continue operating with steam, and continue to improve our steam operation. Surely, then, we must also continue to house and maintain our steam locomotives in suitable fashion. A speaker before the New England Railroad Club, recently, discussing the subject of roundhouses, seemed to think otherwise. He remarked:

> I think the members of this club would be astonished if they knew the extent to which electrification is now under way and contemplated on lines of heavy traffic. In view of this fact, it seems to me fair to question the advisability of putting so much money into a perfect engine-house and appliances for steam locomotives.

This sounds rather panicky. The question discussed was the installation of heating equipment, a ventilated roof, fireproof smokejacks, and the like—all of them necessary elements of a well-built roundhouse. Now, a reasonable depreciation period for a first-class roundhouse may be set at 15 years. Is "conversion" so imminent that we may not figure on such a period? Has the time come when we must resort to temporary shacks for housing our locomotives, in order to be ready for the time when electricity will make roundhouses unnecessary? Let us be a little more sanely conservative than that, and recognize that any neglect to provide well for our present-day locomotives is likely to prove far more costly than any possible loss from scrapping when electric service is inaugurated.

THE INVESTIGATION OF THE BLACKWELL'S ISLAND CANTILEVER BRIDGE.

Ever since the fall of the great cantilever for the St. Lawrence bridge at Quebec, the Blackwell's Island cantilever bridge now approaching completion over the East River at New York City has been under suspicion. While the Blackwell's Island bridge has clear spans of only 1,200 ft., which is only two-thirds that attempted at Quebec, it was designed to carry a very much heavier live load and consequently the dimensions of its members were quite as large as those of the bridge at Quebec.

Had the Quebec disaster been found on investigation to have been due to some local cause such as faulty foundation, or errors in erection, engineers, at least, would have had no cause to distrust the structure at Blackwell's Island. Actually, however, the Quebec Bridge fell because of lack of knowledge by engineers as to the strength of great compression members. In the Blackwell's Island bridge there are compression members designed to carry even greater loads than were carried by the falling chords in the Quebec Bridge; and the design of the compression members in these two great bridges is closely similar. We speak advisedly, therefore, in saying that the Quebec disaster raised a cloud of doubts as to the safety of the Blackwell's Island structure.

These doubts were felt, we are sure, at the time of the disaster by those responsible for the Blackwell's Island bridge, and in fact engineers representing the company building the bridge and the New York City bridge department were early on the ground at Quebec. There was talk at that time of a thorough re-examination of the stresses in the bridge and also of a plan for subjecting some of the big compression members to actual test. This plan, however, appears to have been laid on the shelf; and the recomputation of stresses seems to have progressed at a very leisurely pace.

Meanwhile month after month passed away and the erection steadily progressed. The cantilever arms were joined so that the main trusses were completed and the floor and roadways were put in place. So far as the public was informed, it appeared probable that the bridge would be finished and opened for traffic exactly as if the disaster to the similar structure at Quebec had never occurred.

Most fortunately, however, as is now evident, the public uneasiness concerning the structure finally made such a course impossible. The New York City newspapers, particularly the "Tribune," voiced a public demand that the bridge should not be opened to traffic until some assurances as to its strength and safety were obtained.

As a result of the public agitation, it was finally decided to have two expert investigations and reports made upon the bridge, one by the firm of Boller & Hodge, Consulting Engineers, and the other by Prof. Wm. H. Burr, of Columbia University. These investigations were begun last June. The reports of their results were made public by the Commissioner of Bridges on Friday, Nov. 5, and are printed, substantially in full, in this issue. Not since the Quebec Bridge fell has anything appeared of such interest to bridge engineers generally as these two reports. They contain information astonishing to the last degree.

The Blackwell's Island bridge, it should be explained, was designed at the outset for a "congested loading." Experience with the old Brooklyn Bridge over the East River had made it entirely clear, at the time the Blackwell's Island bridge was projected, that a bridge in the heart of New York City is daily subjected to heavy crowds during the rush hours, and may at any time, through temporary blocking of the traffic, or other causes, be densely packed with cars, teams and people. Even if such congested loading should occur only once or twice in a score of years, it goes without saying that the bridge ought to be made perfectly safe to carry its load at the time when the greatest number of human lives are dependent on its strength.

An expert board of bridge engineers which reported in 1903 on the design of the Manhattan Bridge over the East River advised that the structure should be proportioned for a "congested loading," defined as a possible load which could only occur if special pains were taken to produce it and also for a smaller "regular" loading such as may occur under unusual conditions of crowding at any time.

The Board further advised that this "congested loading" combined with dead load and wind pressure should produce "no stresses anywhere reaching the elastic limit of the material." This recommendation has been interpreted to mean that unit stresses for this congested load just under the elastic limit of the metal were approved by this Board; but such an interpretation is wholly unwarranted.

In the design of the Blackwell's Island Bridge, the "congested live loading" which had been recommended by the Board for the design of the Manhattan suspension bridge was adopted and the resulting unit stresses from dead and live load alone, *with no allowance for wind pressure, snow load, or secondary stresses in the members*, were fixed at 24,000 lbs. per sq. in. for ordinary structural steel.

At the present time the consensus of engineering opinion is doubtless that these unit stresses are beyond the limits of safety and, in fact, Prof. Burr so intimates in his report. But even if any engineers approve such high stresses, they will agree that such stresses represent a limit which should by no possibility be exceeded; and that if any members are stressed materially above this limit, it is cause for serious alarm.

These facts were, of course, perfectly well known to the designers and builders of the bridge, and yet the computation of the stresses now made by two independent authorities shows that the very high unit stresses permitted by the specifications are far exceeded.

Messrs. Boller & Hodge treat this matter in their report very briefly. They say merely:

We made a stress sheet for the loads called for in the specifications; BUT IT WAS EVIDENT THE STRUCTURE COULD NOT SAFELY CARRY THESE LOADS so we had to find the maximum safe carrying capacity of the structure.

The capitalization is ours and is fully justified, we submit, by the importance of the statement. Here is a stupendous bridge—one of the greatest in the world—designed to carry safely a certain loading and contracted for on that basis. On completion it is found to be absolutely unsafe to carry this load. Surely the public is entitled to ask who has blundered and why it is not to receive what it has paid for.

Turning now to Prof. Burr's report we find it much more explicit on the condition of overstrain in the bridge. He states that the specified loading on the structure would stress some of the bottom chord members of the Island span *about 25% more than the specifications permit.* Reduced to figures this means that some of these compression members (concerning whose strength the profession is in grave doubt any way) would carry, if the congested loading were applied, *about thirty-thousand pounds per square inch* (less the usual deduction of a quantity dependent upon the column length and size).

And this is not an isolated case of overstress. The nickel-steel eyebars in the chords of this same span would also be overstressed about 25%, or would carry a unit load of *almost* 49,000 *lbs. per sq. in.* It may be noted here that the specified elastic limit of these nickel-steel eyebars was only 48,000 lbs. per sq. in.

Even this is not quite the worst that Prof. Burr finds. We quote as follows from his report:

"The overstresses in a number of the carbon steel eyebars would range from 10 to 15% in some members in all parts of the structure except in the Queens anchor arm where 30% is reached in one case. There would be also some similar overstresses in riveted tension members in the same parts of the bridge, rising above 33% in a single instance. Few main posts in all the bridge would be overstressed as much as 25%. In the Queens anchor arm there is one post which would be overstressed 33%. The Manhattan rocker arm would be overstressed nearly 20% in tension and 30% in compression, while the Queens rocker arm would be subjected to an excess of 10% in tension and 12% in compression."

"Few main posts in all the bridge would be overstressed as much as 25%," is, we take it, a bit of veiled sarcasm on the part of Prof. Burr, for every engineer knows that it would take precious few such overloaded members to condemn the structure.

It must be remembered in reading the reports of Messrs. Boller & Hodge and Prof. Burr that they are rendered to the Department of Bridges, which is responsible for the design and erection of the Blackwell's Island Bridge. Common courtesy, therefore, forbade anything of a condemnatory tone in the reports, and confined the writers to a bare statement of facts.

Curiously enough, this absence of any condemnatory tone in the wording, coupled with the technical character of most of the report, has led many of the New York newspapers to regard these reports as quite of a reassuring character and they publish extracts from the reports under such headings as "Queensboro* Bridge Safe." It is needless for us to say to our readers that the bare facts given in these reports are more condemnatory to those who understand their full significance than any mere words could possibly be.

And it should be noted here that all the information desired concerning the bridge has not yet come to light. A stress sheet has been given out and is printed in this issue, showing what loads the various members would carry under the loading recommended by Messrs. Boller and Hodge. We still lack the stress sheet showing what stresses would be imposed on these members if *the loads fixed in the specifications* were applied. That stress sheet we hope to be able to obtain and present in our next issue, and in view of the isolated examples of overstress quoted above, it ought to be most illuminating. It may shed some light, for example, on the puzzling question why a bridge with a dead weight of over 35,000 lbs. per lin. ft. can carry a live load of only 4,000 lbs. per lin. ft.

We said above that the report contains material that will astonish the engineering profession. Surely the facts just quoted justify this statement. Here is a huge bridge structure built by a great and wealthy city. There was no need and no thought of attempting to economize in the design, as was done from force of necessity at Quebec. The city bridge department has had on its staff some engineers of high professional reputation, and the structure has been built by a firm of long experience and high standing. Were these engineers ignorant of the stress conditions in the structure? Did they knowingly transgress the limitations for safe stress fixed by the specifications? Would they have deliberately taken the responsibility of opening the bridge to public use in this condition regardless of the terrible object lesson at Quebec a year ago?

A multitude of questions of this sort come to mind. It is a thousand pities that the history of this bridge cannot be investigated by another Holgate Commission as was the history of the Quebec Bridge. The engineering profession might then gain some further knowledge as to how to design—and how *not* to design—great cantilever bridges.

We should not be understood, however, as casting any reflection on the experts who have just reported on the Blackwell's Island Bridge. They were limited by their instructions to certain specified tasks. Their concern was rather as to what load the bridge could safely bear than the reasons why it is too weak to do what it was designed to do.

Turning our attention now to the experts' computation of the load that may safely be placed on the bridge, we find both in agreement as to the limiting unit stresses to be adopted, for members made of ordinary structural steel, viz., 20,000 lbs. per sq. in. for the main truss members, reduced in the case of long compression members by a proper amount. Adopting this as the safe working stress for the metal, Messrs. Boller and Hodge find that the main trusses, as they now stand, can safely carry a live load of about 2,000 lbs. per lineal foot each, and by taking off about 1,000 lbs. per lineal foot of the dead load the capacity can be raised to 3,000 lbs. live load per lineal foot. By assuming a loading of only 50 lbs. per sq. ft. on the roadways and sidewalks, and specifying that trolley cars shall be spaced at least a car-length apart, Messrs. Boller and Hodge conclude that the bridge may be safely opened to pedestrian, highway and trolley car traffic on four tracks, but that the elevated railway tracks cannot be used. Prof. Burr takes off more of the dead load, spaces the cars farther apart and then concludes that one pair of elevated tracks might safely be opened for traffic, provided that the *heads of the trains are spaced at least a thousand feet apart.*

Is it safe to permit this great bridge to be used under such conditions? Is there sufficient assurance that regulations as to the spacing of trains will be actually observed without intermission? Prof. Burr cites practice on the old Brooklyn Bridge in the spacing apart of cars as justification for the adoption of similar precautionary measures on the Blackwell's Island structure. On the Brooklyn Bridge, however, the car-spacing was adopted in view of limitations in the floor system. If through neglect cars should be bunched too closely together, the worst to be expected would be injury of some of the floor members or possibly of some of the stiffening truss members. It is almost certain that any distress in these members from such overloading would become evident before serious accident occurred. But on the Blackwell's Island Bridge, when official neglect—always a possibility, if not a pro[illegible]ity—permits cars and trains to crowd closer [illegible] the limits fixed above, the result will be [illegible] the main *truss members will be overstressed.*

Let us not forget just what [illegible] means. It means that unit stresses of 20,[illegible] lbs. per sq. in., with *no allowance* for snow [illegible], for wind, for reverse stresses, for impact o[illegible] secondary stresses, such as the bending o[illegible] mbers due to their own weight, *may be ex*[illegible] if trolley cars are allowed to run closer th[illegible] car-length apart. Let us not forget, either, that experience at Quebec shows that impo[illegible] members of a truss may be loaded almos[illegible] the point of final failure and yet show [illegible] little external evidence of their condition.

We believe this matter should receive more thorough consideration, at least before the bridge is opened to the public. There is another question, however, that seems to us of even greater importance. That question is the strength of the compression members in the Blackwell's Island Bridge. Will these safely carry the unit stresses which the experts have assumed? What margin of strength will still remain when such a load is applied to them?

Both the expert reports printed in this issue give special attention to the design of these members, and we have studied carefully their discussions of the strength. We fail to find in this discussion any adequate assurance that these posts and chord members can carry safely the load it is proposed to place upon them. Both reports conclude that these compression members are at least as strong against bending horizontally as vertically; but the reasoning on which this conclusion is based is fatally defective in that it leaves wholly out of account the strength—or lack of strength—in the column latticing. It is needless to say that the strength of these huge columns depends as absolutely on the strength of this latticing as did the unfortunate structure at Quebec. The interests at stake are too great and too important to rest on the mere judgment of any man or set of men as to whether this column latticing is strong enough or not.

A year ago the profession fully debated this important matter, and there was substantially no dissent from the statement that some full-size compression members for the largest bridges must be tested under ultimate load before the profession can stand on absolutely sure ground in the design of such bridges. Theories of stresses are valuable and necessary, but they must be reinforced by actual test or we shall fall into more such disasters as that which befell the profession on August 29, 1907.

We call the especial attention of our readers to Prof. Burr's report on this matter. We quote:

Adverse comment has been made on the heavy compression lower chords of this bridge, and that design therefore has been scrutinized with great care. . . . . It will be found by examination of the stress sheet that there are other compression members of the trusses which sustain higher unit stresses with a greater ratio of length over radius of gyration. *There can be no apprehension, therefore, that these lower chord compression members are in any way unsafe* [italics ours—Ed.] or of less unit carrying capacity than other main compression members of the trusses.

And so the lower chord members are safe because the posts are weaker than the chords are! We doubt whether assurances of safety, based on such reasoning, will convince anybody. Evidently it failed to convince Prof. Burr himself, for elsewhere in the report we find him recommending that the Bridge Department have made and tested to destruction not less than six pairs of structural steel compression members similar in cross-section to typical compression members of the Blackwell's Island Bridge and as large as can be tested in the largest testing machine in this country! Why go to this trouble and expense if these compression members are so safe?

Prof. Burr's recommendation for tests is good as far as it goes, but it does not go far enough. Let us frankly face the fact that neither the public or the engineering profession can have confidence in the safety of the Blackwell's Island Bridge until some of its full size members are tested, so that it can be known what their margin of strength really is.

*This is the new official name for the Blackwell's Island Bridge.

Two months ago, in our issue of July 30, 1908, Mr. Gustav Lindenthal brought forward a simple method by which tests on these great columns could be carried out at small expense. Below on this page another engineer presents modifications of this plan. We make no claim here in favor of this or any other particular scheme for carrying out the tests. The point we wish to emphasize is that *such tests CAN be made*; and that they must be made before the Blackwell's Island Bridge can be regarded as safe for public use.

The issues at stake are too vast to permit any trifling or temporizing with this matter. Hundreds and thousands of human beings will pour across this bridge when it is opened, and we must know within reasonable limits what margin of safety there is in its members.

Finally, it is proper to point out that Engineering News has been throughout conservative in its treatment of this matter. We have fully appreciated for more than a year that the safety of the Blackwell's Island Bridge was a matter of grave doubt; but we forbore exciting popular apprehensions, in the hope that those responsible for the public safety would take the necessary steps to remove the doubt. The publication of the reports of Messrs. Boller and Hodge and Burr, however, reveals conditions of overstress and consequent weakness in the bridge never before suspected, in addition to the anxieties regarding the compression members. What we have said above has been merely to present the facts revealed by these expert technical reports in their true light. We are as far from desiring to pose as alarmists regarding the structure as we are from aiding those who are endeavoring to apply to it a coat of whitewash. That coloring won't strengthen the bridge a particle, any more than the confident assurances of those who saw nothing wrong with those bending chords at Quebec could avail to save them from ultimate failure.

LETTERS TO THE EDITOR.

A Simple Plan for Testing Large Bridge Members.

Sir: Your issue of July 30 contained an interesting letter from Mr. Gustav Lindenthal upon tests of large bridge members in which full credit was given to the late Col. Flad for the proposal to use a quarry in making compression tests of heavy structural work.

I expected to see other letters from those who are interested in the subject and who are well qualified by

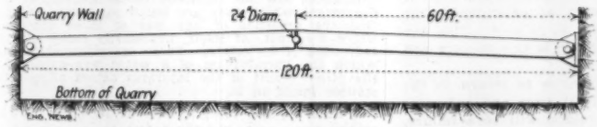


FIG. 1. A PLAN FOR LOADING LARGE COMPRESSION MEMBERS WITHOUT THE USE OF HYDRAULIC PRESSURE.

years of study and experience to discuss such questions. As no such discussion has appeared, I venture to beg—not as a bridge expert but on account of frequent criticisms from correspondents and staff who are experts—for a little space in the excellent "News."

Three features in the method proposed in Mr. Lindenthal's letter are unsatisfactory:

1. The correction to be made for friction in the use of a large hydraulic piston under heavy pressure is an unknown item and cannot be readily determined.

2. The method does not provide for the test of pin connections between two members that are free to move and adjust themselves to the load as they would in actual service.

3. The cost of making the tests by the piston method, which is not to be considered at all in comparison with the value of the knowledge gained, becomes an item of interest if equally good or better results can be secured with less outlay.

The ideal condition in making such tests would be to have two compression members so loaded that they would take the applied stress as they would in the structure for which they were intended. The quarry offers an opportunity for this. Two compression members connected as in actual construction should be placed between the quarry walls with the pin connection midway and a little above the level line joining the centers of the two end pins, as illustrated in Fig. 1. A substantial bed or platform should be provided for containing weights and controlling the movement of the two members. There should also be provision for applying weight to the intermediate pin connection just as weight or stress would be applied through vertical members connected to a panel point in actual construction. It would be easy to determine differences in elevation between the centers of the three pins, a, b, c, within .02-in. and repeated observations would reduce any error to exceedingly small proportions; in fact, errors here might be eliminated altogether.

The accuracy of the test would thus depend solely upon the accuracy with which the load applied on the central pin was determined. There are many methods suitable for loading the intermediate pin connection, but a metal tank of known weight to contain any desired weight of water would be convenient and accurate. With a recorded weight upon the connection b and the difference in elevation between the three pin centers established, the stresses would be at once apparent and the behavior of the two members with all of their various parts—webs, lacings, rivets, etc., could be watched and studied for any desired length of time. Movements due to changes in temperature as well as the behavior under different loads could be readily determined and, as with any test piece, a failure to return to the original position when the load was removed would also be apparent. It may be urged that in such a test the compression members would be in unstable equilibrium and any movement downward of the center pin connection would be followed by increased stresses, continued downward movement and the destruction of the members. This, however, does not follow because weight in excess could be applied while the said connection was firmly supported. Then the weight could be reduced until the pin rose from its support. There would be the delicacy of a scale beam with equally complete control of all the parts. Many niceties of observation and record will occur to the expert in conducting tests of material. Compared with the hydraulic method, friction in this method would be a small item. If it were necessary to take into account the friction due to the movement of the members upon the intermediate pin it could be determined very closely by actual test elsewhere of similar parts under the same pressure per square inch or the intermediate pin could be so shaped that the bearing would become perfect when a given position and the maximum pressure was reached.

Quarries are not always convenient of access and any way to avoid their use for such purposes and to bring all of the work near a bridge shop might be worth noting. Besides it is reasonable to claim that a designer of a product or fabric should be able to test his designs and fabric without depending upon the chance work of other men in some distant locality and also without subjecting property and human lives to needless danger. It will be recalled that the tension members in the Quebec bridge did not fail even under the wrecking strains to which they were subjected. In these days of concrete and reinforced concrete it should not be difficult to provide a base of proper breadth and depth and 50 yds. in length that would offer the necessary resistance. In connection with this base eye-bars and two thrust blocks could be so placed that they would not yield under the imposed loads. The work given to a couple of heavy armor plates or one conning tower would easily provide the block. It is evident that if tests were made by this method, in or out of a quarry, the credit should still be given to Col. Flad.

H. F. Dunham.

220 Broadway, New York City, Oct. 16, 1908.

[Our correspondent's suggestion is a very interesting one and we see no reason why large bridge members could not be given test loads by such an apparatus as he outlines. We may point out, however, that the friction of the pin joints must be taken into consideration in determining the actual stresses in the members under test.

Even a rough computation shows that this friction would be a very considerable amount, probably as large a percentage of the applied load as the friction of a hydraulic piston. It could, however, be determined with a fair degree of approximation and allowance made for it. The friction would be approximately constant for a given compressive stress in the pieces under test, but the load necessary to apply with Mr. Dunham's apparatus would depend on the angle of inclination from the horizontal made by the

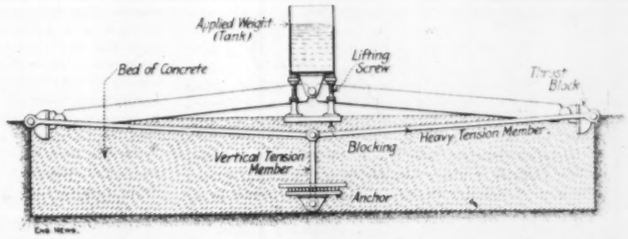


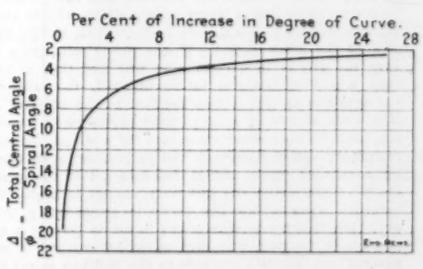
FIG. 2. PLAN FOR A LARGE COMPRESSION TESTING APPARATUS WITH A REINFORCED CONCRETE BED TO TAKE UP STRESS.

two pieces under test. In other words, the flatter the angle of the toggle-joint, the less the force required to produce a given pressure with it. It follows therefore, that to reduce the effect of errors in the determination of friction, the two pieces should be given slope enough to make necessary the application of considerable weight to stress them to their elastic limit.

As to whether the plan proposed would be cheaper than applying the load direct by hydraulic machinery, probably detailed plans and cost estimates of the two would be necessary to settle the question. This, however, is truly a minor matter; and so also is the question of the friction in either apparatus. The important point to the bridge engineers of the country as we see it is that ways have now been made public by which the largest members of great bridges can be loaded to their full capacity, so that their actual margin of strength can be determined. It is of great importance to the engineering profession that such tests be made. Without them we are confessedly working in the dark and risking thousands of lives and many millions of dollars worth of property on the reliability of some theoretical formulas, which are themselves based on experiments made with models of trifling size compared with the members now in common use in modern structures.—Ed.]

Readjustment of Curves in Maintenance-of-Way Work.

Sir: Having done considerable work in readjusting existing curves so as to fit spirals to them, I read with interest the article by Mr. W. H. Wilms in your issue of Sept. 17. I feel that he has outlined quite an amount of work which may ordinarily be avoided when he recommends finding a simple curve which will fit an existing curve, and then finding a curve with spirals which will fit the same track. For some time it has been my custom to try only curves with spirals. This requires methods and formulas a little different from those where simple curves are tried out first. Some of the methods which I have tried have saved me so much time and patience that I feel like passing them on.



The following method has been tried many times with great success.

A. With curves that can easily be run to intersection.

1. Measure Δ and E.

2. Compute R for a simple curve from the formula

$$R = \frac{E}{\text{exsec } \frac{1}{2}\Delta}.$$

3. Select a suitable spiral. One which will give a change in elevation of ½-in. in 30 ft. should first be tried.

4. Find value $\frac{\Delta}{\phi}$ in which ϕ = spiral angle for spiral selected.

If $\frac{\Delta}{\phi} < 3$, select a spiral whose $\phi = \frac{1}{3}\Delta$ or less.

5. From the accompanying diagram find the per cent.

which D must be increased in order to keep track as nearly as possible in the same place.

Note.—This diagram is plotted from different values for $\frac{\phi}{\Delta}$ in the formula

$$D' = [1 + 1.896 \left(\frac{\phi}{\Delta}\right)^2 - 0.672 \left(\frac{\phi}{\Delta}\right)^3] D.$$

This formula is given with Sullivan's spiral tables (standard of the Canadian Pacific Ry.) and is attributed by Mr. Sullivan to Mr. C. C. Wentworth's paper No. 927, Transactions Am. Soc. C. E.

6. Compute distance from *P. I.* to *P. S.* as follows. (In this formula x and y are co-ordinates of the spiral.) $T_s = y - R \sin \phi + x \tan \frac{1}{2} \Delta + R \cos \phi \tan \frac{1}{2} \Delta$.

7. Compute length of simple curve between spirals and try the curve with spirals, setting temporary points.

Should the resulting curve need to be moved in or out at the middle, a new value for R for the simple curve between the spirals may be found from the formula

$$R = \frac{E - x \sec \frac{1}{2} \Delta}{\text{exsec } \frac{1}{2} \Delta - \text{vers } \phi \sec \frac{1}{2} \Delta}$$

Of course when a new value for R is found, a new value for T_s must be computed.

On inspecting the diagram it will be noticed that D' increases very rapidly as $\frac{\Delta}{\phi}$ becomes smaller than 3. Also that when values for $\frac{\Delta}{\phi}$ are between 4 and 3, the change is so rapid as to need special attention. For this reason, I usually compute R from the above formula when $\frac{\Delta}{\phi} < 4$.

B. With curves that cannot easily be produced to intersection.

1. Run a traverse between two points in line with the tangents, as Mr. Wilms describes.

2. If construction or right-of-way notes are at hand, increase original degree of curve as with curves of class A, and try resulting curves with spirals. If such notes are not at hand, estimate degree of curve by taking the average of a number of values of the middle ordinate in inches of a 62-ft. chord.

3. When the first trial curve has been run, if it is not satisfactory, find E from the formula $E = R \text{ exsec } \frac{1}{2} \Delta + x \sec \frac{1}{2} \Delta - R \text{ vers } \phi \sec \frac{1}{2} \Delta$. (For this formula I am indebted to Webb's "Railroad Construction.")

Then take a new value for E and solve for R in the first formula. Note that most of the work of solving for R was done when solving for E.

The use of Mr. Wilm's formula $T = (R + D) \tan \frac{1}{2} \Delta + t$, or the above formula for T_s is optional, but the writer has obtained better results from Webb's formulas and the saving in time occupied in trying lines will more than make up for the slight difference in time required to solve these formulas.

F. K. Beach,
Transitman, Canadian Pacific Ry.

Cranbrook, B. C., Canada, Sept. 30, 1908.

[In accordance with our usual practice we submitted a copy of the above letter to the author of the article, who replies as follows.—Ed.]

Sir: In reply to Mr. Beach's criticism of my article in your issue of Sept. 17, I would say that I did not "recommend finding a simple curve which will fit an existing curve, and then finding a curve with spirals which will fit the same track." If Mr. Beach will again look over the article in question, he will find that in every case where spirals are to be inserted, the temporary curve is run in either from the P.S. or the offsetted P.C. The work of finding a curve with spirals to fit an existing track is no greater than that for a simple curve. A temporary spiraled curve is run in just as in the case of an unspiraled curve, and if this does not fit the existing track satisfactorily, the necessary change is made in the external, after which the curve is permanently staked out. Mr. Beach's method seems to me to involve a great amount of figuring, and then again his method is not a general one, but is applicable to the Sullivan spiral only.

Yours very truly,
W. H. Wilms.

Steubenville, Ohio, Oct. 27, 1908.

The Open Tank Method of Preserving Timber: Results Obtained with Ties and Paving Blocks.

Sir: A recent issue of Engineering News [Oct. 22, 1908.—Ed.] contains an article by Mr. Howard Weiss of the Forest Service, on the open-tank method of preserving timber. Mr. Weiss states that the Forest Service will welcome all criticisms and suggestions tending to advance the work. Therefore I take the opportunity of presenting a few facts pertaining to the results obtained from ties and lumber treated by the open-tank or Seely process, "as it is also known," which have evidently been overlooked by Mr. Weiss.

The Chicago, Burlington & Quincy R. R., in 1868, laid 25,000 ties on the New Boston branch of their road, treated by the open-tank or Seely process as an experiment. These ties failed and were all removed in six years. The failure was due to interior rot. The outer portion to a depth of one-half to three-quarters of an inch was apparently hard and sound whereas the inner wood where the creosote oil had not penetrated had completely failed. These ties caused the Burlington considerable annoyance as, to outward appearances, they were in a perfectly sound condition when it was discovered that the interior was completely rotted.

At the time the Burlington Road made this experiment, the open-tank or Seely process was new, and Mr. Seely undoubtedly performed this work to the best of his ability.

This process also failed on the Chicago, Rock Island and Pacific Ry. in six years, from the same cause as on the Burlington, and it also failed to preserve the pine lumber used in the Government Works on the Saint Clair Flats for a longer period than six years.

Paving blocks treated by the open-tank process have produced good results in several places. In Cleveland, O., some were in use for about ten years. In the City of Paris all paving blocks which are used under heavy traffic are treated by soaking in open tanks of hot oil. They fail from wear in about eight years, and this treatment answers. The blocks used on the boulevards where the traffic is light are given a larger dose of oil, in this case they are subjected to pressure in closed cylinders. They last about 16 years.

The open-tank method of creosoting will undoubtedly produce good results if it is confined to the treating of blocks, shingles, posts, etc., or in other words small-dimension lumber, and it will not be successful in this case unless the utmost care is taken in the seasoning of the lumber before treatment. As to the treatment of railroad ties by this method, a loblolly-pine tie, provided it is thoroughly seasoned, would probably absorb the greatest amount of solution in the least time, but any other class of ties treated by the open-tank process would take from two to three weeks to absorb the same amount of solution that could be injected under 100 lbs. pressure per sq. in. in four hours time.

Undoubtedly the Seely process failed in the treatment of large-dimension lumber for the want of proper seasoning; and the length of time it would take to thoroughly saturate the wood was so great that the treatment was cut short and poor results followed.

The treatment of ties with small doses of creosote oil has not been a success in this country or in Europe, the Robbins process and also the Blyth process failed to give results, and practically all the European countries which are using creosote have for a long time been injecting from 10 to 15 lbs. of oil per cu. ft. of wood, and by so doing obtain a life of from 12 to 20 years.

It can be easily seen where a small dose oil treatment will fail to give results, especially in treating a class of timber like red and black oak and other inferior oaks. This class of timber will rot from the center out in almost all cases, and unless the treatment is pushed to refusal "and this is expensive," it will fail to give as good results as chloride of zinc where ½ lb. of dry salts per cu. ft. is used. This can be verified by the records obtainable in this country and in Europe.

If the tendency in this country is to return to the open-tank or Seely process, great care and judgment should be used, otherwise the results will be a failure, as heretofore.

Yours truly,
J. B. Card, Manager,

Chicago Tie & Timber Preserving Co., Old Colony Bldg., Chicago, Ill., Oct. 26, 1908.

The Massachusetts State Board of Health and New Methods of Purification for Water and Sewage.

Sir: In your issue of Oct. 8, appeared an editorial containing direct and indirect reference to the Massachusetts State Board of Health. Whether the inferences to be drawn from that editorial are justified or not, does not interest me particularly at this time; but, as the policy and methods of the Massachusetts State Board of Health are of very considerable national, and I believe international, interest, I feel that you might be justified in devoting some space in the Engineering News, which is certainly a publication having international influence, to a further discussion of the policy and methods of the Board.

As Consulting Engineer for the City of Lynn, I have made a very careful and critical study of the policy and practices of the Board since its organization, with the result that I am convinced that, whatever the shortcomings of its subordinates or paid agents, the Board itself has always stood for progress and has, as Board, shown a tendency to be ahead of, rather than behind, the times.

You say in your editorial:

> While it (the Massachusetts State Board of Health) has never promulgated set rules . . . . yet by one means or another it has virtually barred out of the State the newer methods of sewage treatment and [illegible]ical filtration of water. . . . Many will [illegible] it has done much to stifle originality and [illegible] both water and sewage purification within [illegible]tion, except as both those qualities have been [illegible] under its own direction at the Lawrence [illegible] Station.

In this, it seems to me, you do not dif[illegible]tween the Board itself and its paid agents. [illegible]mit that by "one means or another" mech[illegible] of water and certain methods of sewage [illegible] have, up to the present time, been prevent[illegible]ting a foothold in Massachusetts, but I fe[illegible] the Board itself is no party to the means [illegible] bring about this result. As to who is res[illegible] these results, which may have been prejudi[illegible] best interests of the State and which have [illegible] influenced, to a greater or less extent, acti[illegible] States, I have as yet been unable to disco[illegible] have satisfied myself that the honorable and [illegible]mbers of the Board have no part in it.

The first State Commission on public health [illegible]chusetts (1850) laid down the broad princip[illegible] which I believe has always controlled the official [illegible]n of the Board, that neither "theory, vague sugg[illegible]s, or presumptive assertion" can decide questions. [illegible] Board early took issue with English sanitarians who w[illegible]ntren-uously insisting that drinking water was the [illegible]-emi-nent cause of typhoid fever and that slow sand filtration was a sure solution for all sanitary prob[illegible] connected with water supply or sewerage.

In its report for 1871, the Board said: "We [illegible]re led to believe, either that English drinking-water must be exceptionally dirty, or that medical observers are unconsciously influenced by pre-conceived opinions based upon ingenious speculations."

In its report for 1873, the Board said: "The water supply of London, although filtered by the companies before delivery to the mains, ... is, ... obviously impure and unsatisfactory."

In its report of 1880, appears an article on malarial fever, then and for some years afterward considered a water-borne disease, which closes with these words: "But theories, it should be borne in mind, serve merely to formulate the knowledge acquired up to a given time; if too dogmatically adhered to, they serve to retard scientific progress by checking the spirit of enquiry."

Clearly up to 1880, the Board was apparently not engaged in the "throttling of originality" whatever it may have seemed to be doing in later years.

In 1890, the Board issued an exhaustive work on water supplies of the State. This work was revolutionary in character, in that it went far in advance of then accepted practice, in the interpretation of the results of the analysis of water, as to the significance of nitrogen compounds in water. The Board said:

> Students of Sanitary Science have attempted to establish certain standards of purity of water based on the determination of nitrogen. The application of these standards of purity has condemned many waters which were certainly unfit to drink, but it is equally certain that many wholesome waters have been thereby also rejected. The fallacy involved in making "standards of purity" based upon organic nitrogen, ammonia, nitrites and nitrates, is apparent when we consider that these substances are not injurious in themselves, at least to the extent which they are found in natural waters, and that the presence of any one of these substances in water does not, of itself, necessarily carry with it any indication of its origin. These are relics of the days in which the harmfulness of a water was supposed to be the direct result of the injurious action of specific substances found in it.

It thus appears that, as late as 1890, the Board were taking issue with "highly arbitrary rules based chiefly on traditions."

In 1891, the bacteriologist of the Board reported that:

> The potato test, upon which much dependence was usually placed, has proven to be totally inadequate for two reasons. First, because the typhoid bacillus does not, under all conditions, give its characteristic growth on sterilized potato; and second, because no fewer than five species (of bacteria) in Lawrence waters under some circumstances present the same characteristics.

In 1895 the Board reported its recommendations as to the establishment of a system of water supply for the Metropolitan District of Boston. The Board considered the project by which water from the Merrimac River should be filtered (slow sand system) and supplied to the district at an estimated cost of $17,500,000, but rejected it in favor of a scheme to store the water of the Nashua River and deliver it to the district without filtration. The storage scheme was carried out at an expense of approximately $40,000,000. The estimated cost of filtering all the water was $2,180,000 while the Board recommended the expenditure of $4,000,000 for the sole purpose of improving the water by storage. It seems beyond question that up to 1895 the Board was not a partisan of slow sand filtration, at least for Massachusetts.

In its report of 1898, the Board said: "It has usually been assumed . . . . that its (B. Coli) presence in filtered water is suspicious, as typhoid may possibly, at times, accompany it, because the place of origin of the two germs is the same, namely, the human intestine." The Board, however, takes issue with this assumption of proof and states that "B. Coli are found in the dejecta from all human beings and some animals, while

the typhoid bacillus comes only from persons who are ill with the disease."

In its report of 1901, the Board states that "tests for the bacillus of typhoid fever in polluted waters are unsatisfactory," and that "the various characteristic appearances (of different species of bacteria) are so variable that only slight reliance can be placed upon them as factors in the differentiation of species." The Board also refers to Whipple's findings that even the forms recognized in the laboratory of the State Board of Health were entirely dependent upon the brand of gelatine used in the tests. This does not seem to show that the Board were clinging to "highly arbitrary rules based chiefly on tradition."

In 1902, the Board reported that, as a result of its investigations, the presumptive test for B. Coli would include 58 species of bacteria, of which only 12 would be included in the colon type as determined at Lawrence. In its report of 1903, the Board takes issue with the accepted doctrine that the relative numbers of bacteria in water before and after filtration is a satisfactory test of the purity of the water or the efficiency of filtration.

Clearly the Board in its official acts is progressive and ahead of, rather than behind, the times. Yet it is true, as you say, that by one means or another, mechanical filtration and the newer methods of sewage treatment have been virtually barred out of Massachusetts.

Why and by whom?

These are questions for which I am now seeking the answer. I have already made some progress and I am very positive in my belief that the honorable members of the Massachusetts State Board of Health will not be involved in the answer.

Yours very respectfully,

Edwin F. Dwelley.

31 Exchange St., Lynn, Mass., Oct. 24, 1908.

[In connection with the editorial note to which the above letter refers we have also received a communciation from which we quote as follows:

With a very few possible exceptions, I believe that the conservative attitude of the State Board of Health has been exceedingly wise; and, while it may have resulted, as you say, in the stifling of originality and progress, it has also resulted in preventing a great many very costly mistakes by the cities and towns whose interests it is the business of the State Board of Health to guard.

It seems to me that one important function of such a board, acting chiefly in an advisory capacity, is to prevent cities and towns from being led into the adoption of schemes by able promoters, although, of course, there may be times when the promoter may have something which is better than the old and tried methods.

In regard to mechanical filtration, you probably did not realize that up to a year ago there were only four systems of water purification in use by cities and towns in Massachusetts, and of these four systems two were of the slow sand type and the other two of the mechanical type.

In regard to sewage disposal, no case has yet appeared in Massachusetts where slow sand filtration, which the Royal Commission finds to be the most effective, could not be adopted at a reasonable cost, and there can be no question that under such circumstances the use of the original schemes which have been suggested would not have been justified, although there is no doubt that much hard feeling has been caused.

We are far from underrating the services to sanitary science which the Massachusetts Board of Health has rendered in the past, and careful reading of the editorial to which our correspondents refer, will show that its purport was rather to state facts than to criticise policies. The contrast we drew between the English Local Government Board and the Massachusetts organization was largely to the advantage of the latter. That the Massachusetts Board's action in the past has actually prevented some communities from embarking on visionary schemes which have afterward proven failures is undoubted; but this conservative policy has also undoubtedly tended to turn inventors and experimenters toward other localities to make trial of their systems.—Ed.]

SEMI-ANNUAL MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The fourteenth general meeting of the American Electrochemical Society was held in New York City, Oct. 30 and 31. The first day's sessions were held at the College of the City of New York and the second day's at the Chemists Club. The weight of the technical sessions was broken on the first day by a luncheon given by the staff of the Department of Chemistry, College of the City of New York, and by a half hour recital on the new great organ of the department of music. There was also a dinner on the evening of the 30th, a smoker at the Chemists' Club on the evening of the 31st, and an excursion, on the afternoon of the same day, to the Balbach Smelting Works at Newark, N. J.

At the first session Messrs. H. H. Porter and F. C. Frary, of the University of Michigan, reported an investigation into the errors in the electrolytic determination of zinc, with a mercury cathode, a method coming into extended use. The prevalence of low results due to hitherto unaccounted losses of both zinc and mercury was confirmed. These were found to be in part due to the general use of impure ether in the washing of the cathode amalgam before weighing.

Mr. G. A. Hulett, of Princeton, N. J., in "Equilibra in Standard Cells" gave the results of a chemical study of the Weston and the Clark standard of E. M. F. He held that the Weston and Clark cells were the only cells accurately reproducible, and that it was improbable that any other combination of metals would be found of service for standard cells. Mechanical subdivision of the materials of the electrode and electrolyte were found to tend to unreliability.

"Chemical Energy" was the title of a rather speculative physical paper by Prof. J. E. Mills, of the University of North Carolina, in which the relations of chemical energy to other forms were discussed. The author claimed that the evidence was:

That the attractive forces, whatever their nature, whether chemical, molecular, magnetic, electrical, or gravitational, which proceed from a particle are definite in amount. If this attraction is exerted upon another particle the amount of the attraction remaining to be exerted upon other particles is diminished by an exactly equivalent amount.

It was also claimed that there was a general resemblance between chemical, molecular, magnetic, electrical and gravitational forces, and that the relation between chemical and electrical forces depended on an unabsorbed chemical attraction as a requisite.

Prof. G. W. Morden, of Toronto, described some laboratory experiments on the fixation of atmospheric nitrogen by low-voltage arcs—90 to 500 volts between electrodes. These arcs were maintained in glass bulbs and air was drawn through the electrical discharge. The nitrous oxide formed was condensed in coils cooled by liquid air. High-air velocities gave the greatest yield per KW-hr. and small velocity gave the highest concentration of nitrous oxide. The author interpreted his results as showing that the fixation process was not wholly a thermal one, but was partly electrical.

The afternoon of the first day was given over to the discussion of the corrosion of iron and steel. Prof. A. F. Ganz, of Stevens Institute of Technology, opened the discussion by presenting the electrical engineers' views and requirements regarding the corrosion of underground structures. He divided such corrosions as came under the engineer's observation into two classes: (1) the purely chemical or electrochemical resulting from no outside causes; (2) the electrolytic through stray currents from outside sources. The electrical engineer, it was said, had two problems: (1) the determination of the electrical condition of the underground system as regards potential difference to other structures and as to currents flowing in, into and out of the system; (2) the design of protective measures at low cost. In studying the electrical conditions of pipe lines it has been demonstrated that continuous lines do carry currents under many conditions. They are apt to pick up currents over a large negative area and discharge through comparatively small areas, causing high current densities and rapid pitting. If the pipe system were connected to other metallic structures, as the rail system of an electric road, other dangers arose such as (1) the liability of heavy currents in high resistance spots with consequent destructive heating and (2) danger to other underground metallic systems.

As an engineer, Prof. Ganz asked five questions of the electrochemists: (1) Are the conditions of underground street rails generally such that the accepted figure for the solution of iron by current, 20 lbs. per ampere-year, holds true, or is the iron apt to be put into a passive state so that current leaves without corrosion? Can "passivity" be so induced? (2) What means are there for determining whether a sample of pipe was corroded by stray currents or by purely local action? (3) Can protection of underground structures be afforded by insulating compounds, in the face of knowledge that all pitch and tar coatings have failed? (4) Is breaking the continuity of a metallic structure feasible? Into how many parts is it necessary to divide accumulated potential? (5) What is a safe current density?

Mr. A. S. Cushman, of Washington, D. C., in the discussion of Professor Ganz's remarks held that there was need of engineers defining "electrolysis," "electrochemical corrosion" and similar terms so as to avoid confusion. He held that there was no way of telling whether a pipe was rusted by stray currents or by local action as the result would be the same except in regard to time.

Dr. C. H. Sharp, of the Electrical Testing Laboratories, New York City, briefly described proper methods of measuring stray currents. He said that the object of such measurements as had been undertaken was to ascertain if at any point any considerable amounts of current were leaving the pipes. Such information could be obtained only indirectly, as it was impossible to insert instruments in the pipe or even in nearby soil without disturbing the old conditions. It was said that while the millivoltmeter measurements have been misused and misinterpreted, yet this instrument can be used to give much valuable information. When a pipe system is positive to the rails of an electric road or to another metallic system there is liability of dangerous corrosion. After the potential studies have been made it is necessary to determine the current flowing from the pipe. To do this it is sometimes best to determine the current flowing in the pipe at different points and for this, if the resistance of the pipe is easily obtained or fairly well approximated, the drops of potential along the pipe line will give good indications. In other cases it has been found well to bring out very heavy leads from the ends of certain section of pipe line and to note the change in potential drop with and without a current (measured) flowing in the leads. This comparison leads to the value of the current normally flowing. By simultaneous reading the current flowing at various points along the stretch of pipe could be obtained and the differences might be considered as the escape. Sometimes it was found advisable to explore the soil about the pipes for currents, and in such work it was necessary to use electrodes that were not polarizable, and methods of study were to be preferred in which potentials rather than currents were to be studied.

Mr. A. A. Knudson, of New York City, described a peculiar case of corrosion in the bottom of certain oil tanks which had been in use seven years. The plates were of riveted iron and the corrosion was wholly on the interior of the tank bottoms and in a peculiar zone across the center in each case. Water had been found in the bottom of the tanks which had 1.6% mineral residue of alkaline reaction and mostly radium salts. While some railway current was found flowing across the tank-yard ground yet there was no corrosion in the walls of the tank or on the outside of the bottoms. The author expressed the belief that lack of homogeneity and presence of abrasion strains with the water as electrolyte caused local currents and consequent corrosion.

Mr. A. S. Cushman in discussing Mr. Knudson's paper called attention to the fact that when alkaline solutions were of less than certain concentration they apparently stimulated corrosion instead of inhibiting, as they did at high concentrations.

Prof. W. H. Walker, of the Massachusetts Institute of Technology, spoke on the function of oxygen in the corrosion of iron. Then he took up the catalizing action of platinum, in contact with iron, in plating out the hydrogen freed by an electrolyte, and showed that mill scale had the same effect in stimulating corrosion at un-

protected points. The protection of iron surface by contact with zinc was shown limited to a certain distance from the zinc which depends on the conductivity of the solution. Such protection became less and less as the distance, along the surface away from the zinc, became greater and such protection as was obtained was at the expense of the zinc. Where slight areas of iron were exposed, as in barbed wire, the deterioration of the zinc was rapid, beginning at the barbs, where the coating was deficient or lacking. Barbed wire had been improved by passing first through a galvanic plating treatment, which gave a heavy initial coating to the barbs.

Internal protection of steam boilers could be provided, it was said, by merely keeping out the oxygen ordinarily carried by feed water. This could be done by a preheater and a dry-vacuum pump. It was shown that even an open heater will drive out most of the oxygen and relieve corrosion troubles. Other schemes proposed embodied passing the water over finely divided iron or the addition of alkaline sodium tannate.

Mr. Maximilian Toch presented a paper on "Simple Methods of Preventing Electrolytic Corrosion." The idea involved in the author's methods was first to keep water away from the steel and secondly to make the water next to the protective coating alkaline or inhibitive. A good linseed oil paint used in five to eight coats had been found to give good protection, but not with fewer applications. The author held that the behavior of iron embedded in concrete depended on the concrete. Some, it was claimed, contained enough sulphites, sulphates or sulphides and other salts so that merely stating that iron was embedded in concrete did not adequately describe the conditions affecting its condition. Neat cement acted as a protector always, but the small percentage present in some concretes caused it to cut little figure in the protection of the iron. The author had secured good results by putting on a lime or alkaline coating to reduce the rust and over that a waterproof covering. For the latter a paint made of red lead and linseed oil (33 lbs. to the gallon) was as good as anything. He also had used an insulating paint next to the pipe and had surrounded this with ½-in. of neat cement.

Mr. A. S. Cushman in the discussion on Mr. Toch's remarks stated that the object of an inhibitive coating, such as a chromate pigment, was to chemically charge the penetrating water before it came in contact with the iron. If a successful exclusive compound could be made there was no need to go to this trouble of studying inhibitive paints. Such a compound had not been found.

The discussions on the last day of the meeting were largely on commercial processes of interest to electrochemists. Mr. F. A. J. Fitzgerald, of Niagara Falls, described the Lash process of making steel. Essentially this consists of heating an intimate mixture of pulverized ore, cast iron and carbon in proper proportions. The process is carried out in the electric or the open-hearth furnace. The author reported some experiments with a Héroult furnace, using 60% ore and 23% cast iron. Complete reduction of the charge was effected by the expenditure of energy at the rate of 0.27 HP.-year per ton of steel. The finished product was turned out for 0.33 HP.-year per ton of cast steel.

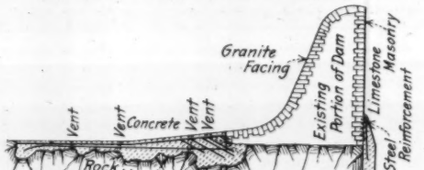
Mr. Carl Hering, of Philadelphia, presented a paper on "Conduction of Heat through Furnace Walls." The author showed that the result from using the usual approximate formulas differed from those of an exact one proposed, by as much as 100%. The author claimed that it was useless to increase the thickness of walls over a certain stage, as the heat saving was too slight for the added cost. He showed curves for determining increase in wall thickness to allow certain heat loss with increase in volume of furnace. It was claimed that the heat loss could be diminished by either heating the furnace walls externally to reduce temperature drop or by artifically cooling them to chill the material and render it a poorer heat conductor.

Mr. E. A. Sperry in presenting the subject of electrochemical loads for central stations asked for agitation among electrochemists for progress in intermittent processes and among central-station managers for giving attractive non peak-load prices for energy.

Mr. John Meyer, in a paper "Electrochemical Loads and the Central Station," maintained that the load factor (ratio of average to maximum energy) should be applied to such loads as proposed in determining costs. The ease of obtaining raw material and of disposing finished product were important factors to be considered. This paper was discussed by many central-station men who seemed to agree that the development was to come through the use of small electric furnaces that could be worked intermittently.

A REPORT ON REBUILDING THE AUSTIN DAM.

The city of Austin, Tex., has recently had under consideration the rebuilding of the great dam across the Colorado River, which was wrecked in a flood in 1900. Plans for the reconstruction have been prepared by Mr. W. G. Kirkpatrick, and a board of consulting engineers was called in to advise the city as to the reconstruction. The board was made up of Messrs. Arthur P. Davis, Louis C. Hill and Thomas U. Taylor. Messrs. Davis and Hill are connected with the U. S. Reclamation Service, and Professor Taylor with the U. S. Geological Survey. The latter will be remembered by many of our readers as the author of the prin-



Proposed Reconstruction of the Dam Across the Colorado River at Austin, Texas.

cipal reports on the dam failure which were published in Engineering News at the time of its occurrence. We reprint as follows the substance of the board's report:

It is unnecessary to rehearse the history of the former work and the failure of the dam. The masonry in the dam is very poor, but this did not cause failure. We have no doubt that the failure was due to sliding. This was facilitated by the upward pressure of water which entered the foundation by means of faults and fissures which abound in this vicinity, and by the erosion of the foundation at the toe of the dam, which removed the only obstruction to sliding except friction. The horizontal beds of limestone are alternated with thin strata of clay or soft rock which when wet served to lubricate the plane of failure below the base of the dam.

The possible precautions to prevent a similar failure are three:

First—Provide a deep curtain wall near the upstream face, to cut off percolation under the dam, so far as possible, in order to reduce upward pressure to a minimum.

Second—Increase the mass of the dam, and thus increase its resistance to sliding and such increase should be so located as to utilize the pressure of water on the dam, so far as possible.

Third—Repair the foundation of the toe of the dam with good monolithic reinforced concrete and carry it down into the natural rock so as to secure its resistance to sliding, and protect it against future erosion.

All of these precautions should be employed if the dam is rebuilt at the old site. We have prepared preliminary drawings illustrating in general the above ideas as applied to the repair of the remaining portion of the old dam, and the construction of the new portion.

After the new dam is placed in service, care must be taken to prevent erosion of the toe from any cause, and frequent examinations taken against its repetition.

The curtain wall should be about 6 ft. in thickness, and connected by steel rods to the main body of the dam. It should be carried to depths to be determined by local conditions as work proceeds, but in general to 20 to 30 ft. below original heel of the dam. It should go below any cavities disclosed by the borings or otherwise.

The east abutment and bulkhead are on very poor foundation, and should be entirely rebuilt, carrying the base below the cavities and leaks that have developed.

The body of the new portion of the [illegible] should be built of concrete with good hard stones [illegible] forming what is called "rubble concrete." [illegible] of appearance the granite facing, on [illegible] should be placed according to the forme[illegible] however, is not necessary on the back of [illegible] it will be concealed by water, though the [illegible] be used for a distance of about ten feet [illegible] where the back will be uncovered in tim[illegible] drought, the remaining portion of the ba[illegible] being of concrete.

There is little value in the old wor[illegible] except the masonry in the western half of the river [illegible] re stands about 500 ft. of the original dam, which [illegible] extensive repair and protection to insure its safet[illegible] The pen-stocks are far gone with rust, and have [illegible] filled and warped under their excessive loads of earth.

The power house is so far wrecked and [illegible] remaining portion is so poorly adapted to future req[illegible] ments, as to be of little use except to furnish mat[illegible] for new construction.

In planning the power house, provisio[illegible] should be made for the installation of about 5,000 HP. [illegible] eventually, which can be advantageously employed in connection with a steam auxiliary. For the present we have assumed that about 3,000 HP. will be require[illegible] and have included its installation in our estimate.

The accompanying preliminary estimate[illegible] have been made of the probable cost of rebuilding the dam and power plant at the present site. These estimates should be used with great caution, as the foundation especially at and below the line of the toe has been [illegible] to an unknown depth, and we have to depend largely upon assumptions regarding the necessary yardage of concrete in the foundation and toe of the dam. The quantity of necessary excavation and concrete for the curtain wall is also very uncertain especially at the eastern end. It has, therefore, been necessary to make assumptions on this point. Owing to local conditions, these uncertainties can not be entirely cleared up until construction is in progress:

The site of the old dam is very undesirable. It is directly across a zone of geological faults, and the river bed is faulted for nearly two miles above the dam site. It will be impossible to prevent percolation under the foundation of the dam. The amount of such percolation is purely conjectural, but it would not only entail a loss of valuable water, but would be to some extent a menace to the safety of the dam. The rock in the foundation is soft and very irregular. If there were no property at this site, we would not regard it as within the realm of consideration.

We have accordingly examined the canyon above, and find that a much better site exists at Mount Bonnell, about 2¼ miles above the old site, where the rock is much harder, and where so far as now known, no geologic faults exist as at or above the dam site. We have been materially assisted in this examination by Dr. F. W. Simonds, professor of geology in the State University. The length of the structure is about the same. No borings have been made here, so no accurate estimate of cost can be made at present. From a rough approximation based upon all the information at hand we are of the opinion that a dam and power house of equal capacity, will cost no more at the Mount Bonnell site than the repair of the old dam and power house. It will be far safer, and will have less water leakage and therefore, a greater available water supply. The cost of maintenance would be much less.

We recommend, therefore, that borings be made at the site selected near Mount Bonnell, the result of which will indicate whether or not it is more feasible than the old site, and from a basis for more accurate estimates of its cost.

If the borings develop a condition of foundation such as we expect, it will be entirely feasible to build a higher dam which would provide a greater head available for power, and the great area of the upper layers of water will provide a large capacity for the storage of the frequent floods, and thus greatly increase the available water supply. This would increase the power possibilities in greater proportion than the increase of cost.

ESTIMATED COST OF REPLACING AUSTIN DAM AND POWER HOUSE.

Rock excavation for cut-off wall, 8,000 cu. yds. at $3 per cu. yd.	$24,000
Concrete in cut-off wall, 9,000 cu. yds. at $6 per cu. yd.	54,000
Excavation for dam to wall and apron, 80,000 yds., at 75 cts. per cu. yd.	60,000
Reinforced concrete in toe-wall and apron, 40,000 yds. at $6 per yd.	240,000
Concrete and facing in main dam, 74,000 yards at $8 per cu. yd.	444,000
Excavation for east abutment, 3,500 yds. at $2 per cu. yd.	7,000
Concrete and facing in main dam, 3,500 yds. at $6 per cu. yd.	21,000
Sluice gates	5,000
Power house and three units	200,000
	$1,055,000
Engineering and contingencies, 15%	158,500
Total	$1,213,500

COST DATA OF THE COLD SPRINGS RESERVOIR CONSTRUCTION, OREGON, U. S. RECLAMATION SERVICE.

From advance sheets of the "Reclamation Record" for November we take the following regarding the costs of constructing the Cold Springs reservoir on the Umatilla Project, the work being done entirely by force account. The dam which forms the reservoir is an earth embankment about 3,200 ft. long and 82 ft. in maximum height. A notable paper descriptive of the materials used in the dam by Mr. D. C. Henry, M. Am. Soc. C. E., and Mr. E. G. Hopson was published in our issue of March 7, 1907.

The article printed in the "Reclamation Record" is as follows:

In the accompanying tables showing the cost of the various features of the Cold Springs Reservoir, Umatilla Project, constructed by force account, the cost of construction engineering is included under general expense and an average of about 4 or 5% of the charges under general expense may properly be charged to superintendence. In Table I. the cost of embankment covering the main part of the dam is made up of that of the gravel embankment, earth embankment and rockfill embankment, excavated and hauled directly therefor, and that of overhaul on 17,761 cu. yds. of Class 1 excavation from the spillway. Table II. shows the distribution of cost among these distributions of embankment.

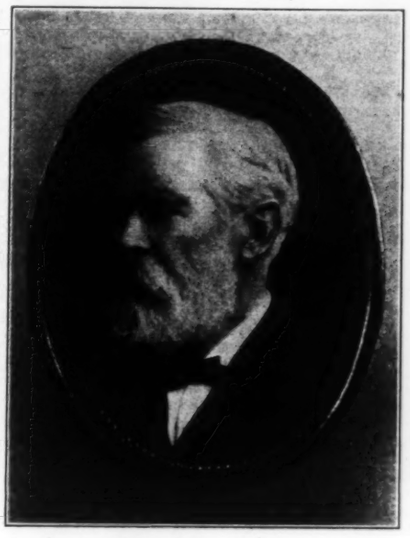
The gravel portion of the embankment was excavated with a steam shovel and hauled from the gravel pit to the embankment, an average distance of a little over one-half mile. The steam shovel engineer was paid at the rate of $6.20, the craneman $4.00, locomotive engineer $3.60, fireman $2.40 to $3.20, and laborers $1.60 to $2.40 per 8-hour day.

The earth portion of the embankment contains 40,870 cu. yds. of Class 1 and Class 2 material from the cut-off and drainage trenches and the outlet works, 17,761 cu. yds. of Class 1 material from the spillway, 22,396 cu. yds. from borrow pits placed with Fresno and wheel scrapers and wagons and 86,411 cu. yds. of material from borrow pits, excavated with an excavator equipped with an orange-peel bucket. Forty-six cubic yards of Class 2 material from the cut-off and drainage trenches and outlet works were wasted, although charged against embankment in Table I. About 116,600 cu. yds. of Class 1 material incidentally excavated at the gravel bank were used for the earth embankment. The cost of this portion of the earth embankment has been assumed to be the same as that for the gravel portion of the embankment owing to similarity of conditions concerning its excavation and transportation. Laborers were paid at the rate of $1.60 to $2.40, engineers $4.00, teamsters $2.40 to $2.60, and teams $1.00 per head per horse per 8-hour day.

All of the rockfill portion of the embankment was obtained from a nearby rock cliff with the exception of 3,414 cu. yds. of Class 3 excavation from the cut-off and drainage trenches and the outlet works. The material used was easily blasted and was delivered to the embankment with engines and dump cars. Five hundred twenty-four cubic yards of Class 3 excavation from the cut-off and drainage trenches and the outlet works were wasted, although the cost thereof is charged against embankment in Table I. The rates of wages paid for this portion of the work were the same as those for earth embankment, with the exception that locomotive engineers were paid at the rate of $3.60 and firemen at the rate of $2.40 to $2.60 per 8-hour day.

A DINNER TO COL. GEORGE EARL CHURCH.

As many of the readers of Engineering News are probably aware, the Madeira and Mamoré Association is made up of the survivors of those who took part in the famous expedition to build the Madeira & Mamoré Ry. in Brazil in the year



Col. George Earl Church, M. Am. Soc. C. E.

1878. The feature of the association is the annual dinner held in Philadelphia. A year ago the association was brought into special notice by the publication of the history of the Madeira

The First Locomotive for the Madeira & Mamore Ry., First Run on July 4, 1878.

& Mamoré enterprise, prepared by the association's historian, Mr. Neville B. Craig. A review of this book was published in our Engineering Literature Supplement for Oct. 17, 1907.

On the evening of Monday, Nov. 2, the association gave a complimentary dinner in honor of Col. George Earl Church, at the Bellevue-Stratford Hotel in Philadelphia. Colonel Church spent eleven years of his most active life, from 1868 to 1879, in promoting the Madeira and Mamoré enterprise, and it was under his direction that the work done in 1878 was carried on.

Although a native American, and prominently engaged in railway construction in the United States in his early life, Colonel Church has long been a resident of London, where he has been engaged in the development and promotion of Canadian railway enterprises.

As our readers know, the Madeira & Mamoré Railway work was resumed a year ago, and it is of interest to note that the old locomotive, named in honor of Colonel Church and run on the construction railway, where a few miles of iron rails were laid down in 1878, was found still in existence by the expedition of last year. We reproduce herewith a photograph of this old locomotive, which has the distinction of being the first ever run above the city of Para in territory drained by the Amazon. We also reproduce, from the attractive menu card of the dinner of Nov. 2, a portrait of Colonel Church.

A MINE EXPLOSION at Rend City, Ill., Nov. 5, entombed four miners. A rescuing party tried for 24 hours to reach the buried men but without success. Eighteen horses and mules were in the mine at the time of the explosion and were killed.

AN OPEN SWITCH CAUSED A WRECK on the Huntingdon & Broad Top Mountain R. R., near Saxton, Pa., Nov. 6. A passenger train ran through the switch and crashed into a string of freight cars on the siding. Seven men were injured. The locomotive and combination baggage and mail car were wrecked.

A PECULIAR MINE CAGE ACCIDENT occurred at the Lance colliery at Wilkes-Barre, Pa., Nov. 3, according to a newspaper report. As the cage was approaching the top, the engineer in charge of the hoisting engine discovered that some accident to the throttle prevented his stopping the engine. There was one miner in the cage. The engineer, with great presence of mind, reversed the engine and kept on reversing it whenever the cage approached the top or bottom of the shaft until other employees arrived and shut off the steam. The miner, after having been alternately hoisted and lowered some 30 or 40 times at full speed was in a state of collapse. It is not explained why the hoist was not equipped with a clutch and brake.

FOUR DYNAMITE EXPLOSIONS have been reported in Canada. Half a ton of dynamite on a scow moored alongside the guard pier, 2,400 ft. from the buildings fronting on Commissioner St., Montreal, exploded Nov. 8, causing, it is said, a loss of $50,000 in broken windows in the buildings on Commissioner and St. Paul Sts.

Four men at Olsen & Larson's camp, 24 miles north of Ingolf, Ont., were drilling in the face of a rock cut and struck an old charge which exploded, killing three of the men and seriously injuring the fourth.

The premature explosion of a heavy charge of dynamite, Nov. 3, in a rock cut on the Transcontinental Ry., 18 miles north of Dryden, Ont., buried eleven men under tons of rock. Seven were killed and four seriously injured. An investigation is under way to ascertain the reason for so many accidents of this nature in the construction work of this line.

A miner at the Chambers-Ferland mine, near Cobalt, struck an unexploded charge with a pick, Nov. 2, and died the next day from injuries received in the resulting explosion.

CARBON MONOXIDE FROM A WATER HEATER burning illuminating gas is said to have caused the death of two women and a child in Washington, D. C., Nov. 6. The accident occurred in a second-story apartment on First St. The rooms were small and the windows and transoms were closed at the time of the accident. In the kitchen, which is described as "closet-like," were a gas range and an upright, tubular gas water-heater. The newspaper reports state that the range had not been lighted the day of the accident, but do not explain how this was learned. It is not stated whether or not the heater was found lighted. The bodies of the women were found late in the afternoon close together in the kitchen near the doorway leading into the dining-room, in which was the body of the child. Prof. W. W. Skinner, of the Bureau of Chemistry of the Department of Agriculture, ascribes the deaths to the formation of carbon monoxide in the heater due to a poor burner or

TABLE I.—COST DATA FOR COLD SPRINGS RESERVOIR, U. S. RECLAMATION SERVICE.

Feature.	Unit.	Quantity.	Building cost.	Engineering.	General expense.	Total cost.	Unit cost.
Embankment	.....	.....	$289,756	.....	$34,284	$324,041	.....
Main spillway	.....	.....	28,010	.....	3,706	31,716	.....
Concrete, Class C, outlet	cu. yd.	712.3	10,547	.....	1,100	11,647	$16.40
Concrete, Class D, cut-off walls	cu. yd.	327.1	3,742	.....	398	4,140	12.64
Inlet, concrete	cu. yd.	147.5	1,700	.....	179	1,879	12.75
Inlet riprap	cu. yd.	64	201	.....	25	227	3.56
Drainage, 4-in., 6-in., 8-in. tile	lin. ft.	2,937	900	.....	94	994	.34
12-in. concrete drain pipe	lin. ft.	846	2,862	.....	360	3,222	3.80
Bridge and gates, outlet tower	.....	.....	5,207	.....	601	5,808	.....
Feed canal, excavation and chute	.....	.....	11,190	.....	1,186	12,376	.....
Inlet steps, concrete	cu. yd.	6.6	149	.....	29	179	27.12
Buildings	.....	.....	13,107	.....	1,467	14,574	.....
Surveys	.....	.....	.....	$2,886	300	3,186	.....
Design	.....	.....	.....	1,500	156	1,656	.....
Cleaning up	.....	.....	212	.....	40	252	.....
Transfer of plant to Hermiston	.....	.....	33,553	.....	722	4,275	.....
Total	.....	.....	$371,143	$4,386	$44,650	$420,180	.....

TABLE II.—DETAILED COST OF EMBANKMENT, COLD SPRINGS RESERVOIR.

Item.	Unit.	Quantity.	Building cost.	General expenses.	Total cost.	Unit cost.
Gravel	cu. yd.	473,400	$151,629	$17,594	$169,224	$0.357
Earth from gravel pit, borrow pits and spillway	cu. yd.	243,168	74,742	8,804	83,547	.344
Rockfill from cliff	cu. yd.	32,494	38,440	5,259	43,699	1.35
Excavation, Class 1	cu. yd.	34,342	8,233	881	9,114	.265
Excavation, Class 2	cu. yd.	6,574	7,390	768	8,158	1.25
Excavation, Class 3	cu. yd.	3,938	9,320	978	10,298	2.62
Total	.....	.....	$289,756	$34,284	$324,041	.....

improper management. The heater is being tested to determine the amount of CO generated when the pilot light is made to "strike back."

THE ILLINOIS DEEP WATERWAY bond issue appears to have been adopted by the voters of that state, as the result of the election held on Nov. 3. At many interior points very little interest was shown, and comparatively few voters marked the special ballot for the waterway. In the towns along the river routes, however, the vote was strongly in favor of the waterway. Up to Nov. 9, the returns from 41 counties (out of a total of 102) indicated a vote of 5 to 1 in favor of the project, while in Cook County (Chicago and the vicinity) the vote was 8 to 1. The vote was directly upon the proposition for the state to issue $20,000,000 for a waterway from the end of the Chicago Drainage Canal to the Illinois River at La Salle. The project was described in our issue of Oct. 15.

PERSONALS.

Mr. T. H. Ceperly has been appointed Chief Engineer of the Stuyvesant Falls power plant of the Albany & Hudson R. R., to succeed Mr. W. G. Andrews.

Mr. H. B. Thayer, Assoc. Am. Inst. E. E., Vice-President of the Western Electric Co., has become President of that company, succeeding Mr. E. M. Barton, Assoc. Am. Inst. E. E.

Mr. H. H. Woodman has been appointed Chief Engineer of the Missouri Southern R. R., to succeed Mr. G. W. Payne, resigned. Mr. Payne's resignation is to take effect Nov. 15.

Mr. William E. Keily, Managing Editor of the "Western Electrician," has resigned owing to a change of ownership in that paper. His present address is 6503 Minerva Ave., Chicago.

Mr. Charles William Eliot, President of Harvard University has resigned. His resignation is to take effect in May, 1909, when he will have completed his 40th year in his present position. President Eliot is nearly 75 years old.

Mr. W. R. Edwards, Assoc. M. Am. Soc. C. E., has been appointed Assistant Engineer of Bridges of the Baltimore & Ohio R. R., with headquarters at Baltimore, Md. Mr. Edwards was graduated as a Civil Engineer from Washington University at St. Louis, and his first work was as a field engineer on the construction of the bridge across the Mississippi River at Memphis, Tenn., in 1889. He was later employed in the drafting department of the Pencoyd Iron Works, now a part of the American Bridge Co. Mr. Edwards came to the Baltimore & Ohio in June, 1894, as an inspector of bridge and track materials and continued in such capacity on the reconstruction of bridges and rehabilitation of the property following the receivership. He was promoted to Chief Bridge Draftsman June 1, 1907, which position he has filled up to the present time.

Obituary.

John E. Haworth, Assoc. Inst. M. M., was stabbed and instantly killed at the Mina Poderosa, Huelva, Spain, Sept. 24.

Walter A. Dennison, President of the American Oil Development Co., of Pittsburg, Pa., died Nov. 5 at his home in Brooklyn, N. Y. Mr. Dennison was born in Philadelphia in 1852.

Francis H. Fassett, architect, died Nov. 1 at Portland, Me., at the age of 85 years. Mr. Fassett designed the Maine General Hospital, the Portland Public Library, Portland High School and several grammar schools and churches in New England cities.

James McGraw, railway contractor, died Nov. 3 at his home in Philadelphia. Mr. McGraw was at one time connected with the engineering corps of the Pennsylvania R. R., and his first work as a contractor was the building of the Frazer branch of that system.

Henry A. Butters, President of the Northern Electric Ry., died Oct. 26 at Berkeley, Cal. Mr. Butters was born at Haverhill, Mass., in 1850. He has been connected with the installation of electric railways in Switzerland, Mexico, Portugal, South Africa and Chile.

William D. Cornish, Vice-President of the Union Pacific R. R., died at the Auditorium Annex in Chicago, Ill., Nov. 7. His death is attributed to heart failure. Mr. Cornish was born in Plymouth, Mass., about 59 years ago. He was director of a number of railway and steamship companies.

G. Edward Sleeper, M. Am. Soc. C. E., of Boston, Mass., died Oct. 25, at his home in East Orange, N. J., in his 53d year. Owing to ill-health during the past few years, Mr. Sleeper has done very little work, but previous to his illness he was engaged in active practice for 15 or 18 years, much of his work being in connection with electric railways in the New England States. Mr. Sleeper was a member of the Boston Society of Civil Engineers. He is survived by a widow and two sons.

Herbert D. Hale, the architect who designed the Engineering Societies' Building in New York City, died Nov. 10 at his home on 55th St. in New York. His death concluded a long period of illness and nervous disorder. Mr. Hale was born in Boston, Mass., in 1806, and was one of the younger sons of Rev. Edward Everett Hale, now Chaplain of the U. S. Senate. He entered Harvard in 1884 and immediately after his graduation went to Paris, where he took the regular course at the Beaux Arts. Among the buildings designed by Mr. Hale is the new Post Office Building now being erected in New Orleans, La. Mr. Hale is survived by his wife, who was a daughter of the late Henry G. Marquand, of New York City, and five children.

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN RAILWAY ASSOCIATION.
Nov. 18. Annual meeting at Chicago, Ill. Secy., W. F. Allen, 24 Park Pl., New York City.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 19-20. Annual meeting at New York City. Secy., W. J. Baxter, 29 West 39th St., New York City.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Nov. 30-Dec. 1. Annual meeting at New York City. Secy., W. H. Ross, 154 Nassau St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 1-4. Annual meeting at New York City. Secy., Calvin W. Rice, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF ARCHITECTS.
Dec. 15-17. Annual convention at Washington, D. C. Secy., Glenn Brown, "The Octagon," Washington, D. C.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The important subject "Forests and Reservoirs in Their Relation to Stream-Flow" was brought before the meeting of Nov. 4, 1908, through a paper under this title by Lt.-Col. H. M. Chittenden, Corps of Engineers, U. S. A. The paper is a voluminous discussion of the claims, impressions and arguments which support the widely prevalent view that forests tend to regulate runoff, i. e., to lower flood heights and raise low-water stages. The author asserts that this view has no sound scientific basis. The conclusions reached by Col. Chittenden were summarized editorially in our issue of Oct. 29, p. 478.

Mr. Gifford Pinchot, Chief of the Bureau of Forestry, and Mr. M. O. Leighton, Chief Hydrographer of the U. S. Geological Survey, whose publicly expressed views, respectively for forestry as justified by the stream-regulation argument and for stream-regulation as influenced by the forestry argument, are controverted by Mr. Chittenden's paper, were present to oppose him, and spoke at considerable length. Mr. E. P. North also spoke in discussion, but on a more general subject, namely the general forest policy of the government, rather than on the specific point of contention raised by the author. The hour then was so late that several communicated discussions were not read; they were from A. M. Todd, S. Child, T. P. Roberts, F. Collingwood, F. B. Maltby and J. F. LeBaron.

Mr. Pinchot began by an exposition of the function of the forest floor in conserving rainfall. Correcting a former illustration used by him and attacked by the author, he said that the real storage place is not the mulch itself but the soil beneath as a whole, and the action of the porous top stratum is to retain the rainfall long enough so that it can sink into the earth below. The groundwater is the storage, not the small amount of moisture held in the layer of mulch. "A large part of Col. Chittenden's argument falls as a result of this correction," claimed Mr. Pinchot. Concerning the question whether forests increase rainfall, Mr. Pinchot stated that the weight of opinion is that they do, and this is supported theoretically by the observation that the air over a forest is cool, to a considerable height, which would induce precipitation from warmer saturated air currents, especially in the case of forests on mountain slopes. But, he claims, the influence on rainfall is of but minor importance. The chief thing is the regulating effect of runoff. On this point the author had cited the case of the Sacramento Valley in California, where the timbered area of the American River, on the east side of the valley, showed a higher runoff for smaller rainfall as compared with the Puta Creek area, on the west side of the valley, according to his figures. On checking up these figures, Mr. Pinchot said, it appeared that the rainfall figure for the American River valley was the actual mean of the rainfall records of all the stations inside its watershed; but the author's figure for Puta Creek seemed to be derived from only two stations, one just inside and one just outside the drainage area, and both of them near the summit. Mr. Pinchot took two further stations inside and three more outside the area (total 3 inside, 4 outside, one being as much as 20 miles outside), and by averaging their rainfalls obtained a much lower rainfall figure. By drawing isohyetal lines on the basis of the rainfall records and therefrom determining a mean precipitation, a similar discrepancy developed, thus:

	Puta Creek rainfall.	American River rainfall.
Chittenden	22.7 ins.	14.6 ins.
Pinchot (averaging)	9.4 ins.	14.6 ins.
Pinchot (isohyetals) ...	10.9 ins.	16.7 ins.

The corrected comparisons show (1) o[n the] averaged rainfall, the American River h[as] rainfall but only 23% greater runoff p[er] (2) by isohyetals, the American River h[as] rainfall and only 23% greater runoff. S[o] can River area is steeper than the othe[r] the result is taken to demonstrate clearl[y] forests in reducing runoff. It should be n[ot] that the American River has much the l[ess] area.

But flood height, he added, is not the m[ain] matter, except as regards river protectio[n] chief thing is the frequency and duration [of] and low-water periods. These latter we[re] a number of streams, together with rainfa[ll] the charts for three rivers were shown: [the] hela at Lock 4, the Cumberland at Burns[ville] the Red River at Arthur, Tex., for the years [1890] to 1907. The average lines which were drawn on [the] purported to show for the former two r[ivers an] increase of number of days of both high w[ater] and low water, from 1890 to now, and at the sam[e time a] decrease of rainfall. However, the plotted [records] are naturally very irregular, and the straight [lines] drawn to average the several plots might have b[een] changed considerably in slope without appearing less [true] to fact. In spite of this, and the short period of [time] covered, Mr. Pinchot interpreted them as proving d[efinitely] that flood frequency and low-water frequency increases as deforestation proceeds, even though the [rainfall] decreases. He also concludes that the Red [River] chart proves that extensive soil culture has the [same] effect as forests.

The other remarks by Mr. Pinchot addressed themselves to minor points of the author's argument and to his recommendations for lowland forests in preference to mountain forests. The forests-and-stream-flow subject is so much more important, however, that we need not refer to them at length. Briefly, he charged Col. Chittenden with a "complete and thoroughgoing misunderstanding of the foundations of forestry."

Mr. M. O. Leighton's remarks were intended to supplement those of Mr. Pinchot. He objected primarily to the author's rejecting popular beliefs because not demonstrated by figures, without giving numerical proof of the opposite assertions. In Col. Chittenden's admission that many springs and minor sources of water may be dried up by deforestation, he finds a proof that low water stages are lowered, since it cannot be conceived that a river retains the same quantity of flow when most of its ultimate sources have disappeared. He attacked the whole of the author's statements as to snowfall, because snow melts from the bottom rather than the top, because forests do contain snowdrifts, and because the drifts after all form only an insignificant part of the total snowfall. Concerning the absence of long-time records of rivers, which the author deplores, he said that the Geological Survey has shown conclusively that a 10-yr. period comprehends practically the entire range of conditions likely to occur (with the exception of a few rare floods), while the Weather Bureau claims even a shorter period.

That the author makes gage-heights the criterion, a point already attacked by Mr. Pinchot, was also opposed by Mr. Leighton, who declared it to be a misconception of the subject to expect to find higher maximum floods as deforestation proceeds. He also claimed that if the rainfall figures were coupled with the author's tabulated records of flood heights they would disprove the inferences therefrom. Thus, the Tennessee River at Chattanooga, he stated, shows a marked reduction of floods, but if they be compared with the rainfall it will be found that relatively the flood heights are increasing. The gage at Pittsburg, for which the author gave figures, is not in a good section of the river, so that the gage height is not an accurate indication of the flow. As to deforestation in the Ohio Valley, moreover, he roundly denied the author's statement that the important inroads into the timber of the Ohio's drainage area were made many years ago; and a similar remark applies to the Connecticut River.

Flood damages in the United States in 1908 have been made the subject of a careful estimate by the Geological Survey. The year's damage up to Aug. 1 was no less than $265,000,000. No estimate has yet been made of damage to crops from drought, but it can be nothing like this sum, or nothing like even the $180,000,000 flood damage of 1907. The author's claim that droughts do more injury than floods does not seem valid.

After some further detail remarks on stream flow, Mr. Leighton referred very briefly to the reservoir system which is likely to be agitated before the Inland Waterways Commission. He asserted that the reservoir expenditure will prove the best investment that the government can make, and that the decision to enter upon it will be the most important action of the country since the ratification of the Constitution. The reservoir system, said Mr. Leighton, rests on the fundamental idea of developing the river as a unit, and no approach to that idea has been made in all the work on the United States rivers done up to the present day.

ENGINEERING LITERATURE

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EDITORIAL.

Many engineers are already familiar with the fact that a great amount of useful matter to engineers is being published by the United States Government, and many of these documents can be obtained for a nominal price. The distribution of these publications is in charge of the Superintendent of Documents. A brief catalog just issued by this official describes an extended list of publications relating to engineering and mechanics. Copies of this catalog are sent free on request. Applicants should specify Price List 18, "Engineering-Mechanics." A new price list on the subject of Transportation, to be numbered 25 in the series, will be issued in a short time. A smaller price list, known as a "Leaflet" series, is also issued for free distribution, and No. 5, relating to the aging of cement and documents on the production and use of cement, will be of interest to many engineers.

The consolidation of the "Electrical Review," of New York, and the "Western Electrician," of Chicago, was announced during the past month. This recalls to mind the merging of the "Electrical World" and the "Electrician" a few years ago. Concentration of effort in the field of electrical journals seems to be fashionable. But the reduction in number of electric periodicals is, perhaps, more apparent than real. Within the last few years two new journals have appeared, more or less directly under the auspices of the two chief electric manufacturing companies, and in addition, the monthly publication of the American Institute of Electrical Engineers has taken on something of the style and manner of a commercial periodical, so that, it might be said, three electrical journals have been added, for two that disappeared. Be that as it may, we tender our good wishes to the "Electrical Review and Western Electrician," which is the product of the latest merger. It is to be published in Chicago, retaining the management and personnel of the "Electrical Review." A New York office is to be maintained also. The first issue of the new journal appeared under date of Nov. 7.

A recent notice from France indicates a rather novel interrelation of the two most prominent French technical journals, "Le Genie Civil" and "Annales des Ponts et Chausées," in the appointment of M. A. Dumas, the managing editor of the former, as publisher of the latter. The "Annales," as many of our readers know, is the official organ of the French Bureau of Public Works, so that M. Dumas' position as publisher is, in a way, a governmental one which cannot interfere with his private editorial capacity.

REVIEWS.

Internal Combustion Engines.

Reviewed by LIONEL S. MARKS.*

INTERNAL COMBUSTION ENGINES.—Their Theory, Construction and Operation. By Rolla C. Carpenter, M. M. E., LL. D., and H. Diederichs, M. E., Professors of Experimental Engineering, Sibley College, Cornell University. New York: D. Van Nostrand Co. Cloth; 6 × 9½ ins.; pp. 597; numerous text illustrations and tables. $5, net.

The literature of the internal combustion engine has been growing very rapidly in the past few years, but it includes very few books which are of any real service to the investigator or designer. There is one book which is both comprehensive and thorough and which stands in a class by itself. It is Güldner's "Entwerfen und Berechnen der Verbrennungsmotoren." Unfortunately this book has not been translated into English, and so is unavailable to the majority of English-speaking engineers. The English books by Dugald Clerk and Bryan Donkin need badly to be brought up to date. The one American book of any value treats of part of the subject only. Under these circumstances there is obviously plenty of room for a good and comprehensive work presenting to the English-speaking engineer the principal results of gas engine investigation and practice.

Much of the work in gas engine investigation has been carried out in Germany. The researches of E. Meyer, Schöttler, Körting, Slaby, Gü'dner, Langen and others have done much to clear up many gas-engine problems. The results of this very important body of work have been unknown to the great majority of English-speaking engineers because they have not been incorporated in English books. Professors Carpenter and Diederichs have done a good service in extracting what is most valuable from German literature and incorporating it in their book. It is the most notable respect in which their book differs from others. The book is a serious and thorough piece of work. All the important sources have been careful'y studied and good critical judgment has been employed in the selection and rejection of material. That it owes much to Güldner's book is very evident, but in its arrangement and methods it has its own strongly marked individuality.

There are four principal divisions to the book. The first five chapters are occupied with definitions and theoretical considerations; the next five with fuels and the phenomena of combustion; then follow four chapters on gas-engine construction and operation; finally there are four chapters on power estimation, testing, results of tests and costs.

The first chapter is a very unsatisfactory hodge-podge. Why is it necessary in such a work to devote a page to Celsius, Fahrenheit and Réaumur, or another page to a description and picture of a simple "mercurial" thermometer, especially, when a thing so obscure as the Baumé scale of densities goes unexplained? The second chapter gives a good digest of the laws of thermodynamics and their application to perfect gas. It is surely undesirable to use the phrase "heat transmission" to mean the amount of heat absorbed or rejected by a mass of gas. Energy transmission has a definite meaning for engineers as distinguished from its utilization.

In the chapters devoted to the comparison of the various gas-engine cycles the very illuminating method due to Eugen Meyer is used. The modifications of the ideal cycles which occur in practice in the four-stroke Otto cycle are handled in an excellent way. It would have been well in discussing volumetric efficiencies to have added some of the results of American experience to Güldner's values, but it is difficult to get much information on that subject. The least satisfactory section of this chapter is that dealing with the phenomena of the combustion and expansion lines. There is throughout the discussion the tacit assumption that combustion is practically instantaneous, and various actions are suggested as explaining phenomena which are probably in great part due to slow combustion. The recent work of several physical chemists has thrown much new light on the rate of chemical reactions, and we know now that explosive reactions do not necessarily (or even generally) proceed to completion with accelerated velocity. Explosive reactions start with rapid acceleration, but after a while the relation between the concentrations of the reacting substances and the temperature of the mass becomes such as to cause a rapid decrease in the rate of reaction. The particular moment at which the reaction begins to slow down depends on the composition of the explosive mixture and on many other factors. It is the fact that a retardation is to be expected that is apparently lost sight of by most writers on this subject.

A whole chapter is devoted to the application of the temperature-entropy diagram to the gas-engine. The diagram is drawn on the assumption of constant specific heats of the gases and consequently there can be no value in any deductions from it. Even if the variation in the specific heats were known and taken into account (which would still further complicate the translation of a pressure vo'ume into a temperature-entropy diagram), and if it were generally practicable to determine the temperature at some one part of the cycle (which is one of the necessities in constructing the diagram), the results when obtained are of such problematical value that it is very doubtful indeed whether it is at all worth while. The heat exchanges during any part of the cycle can be determined by heat balances quite as well as by this diagram. The diagram does not inform us whether heat is actually suppressed or whether it is being absorbed by the walls as soon as generated. The temperature-entropy diagram is to a very great extent a fad. Its value is apt to be vastly overestimated by college professors, and it certainly is not worth a whole chapter in a book on gas-engines.

The treatment of combustion and fuels is good. Gas producers are discussed only in the briefest possible way, but the discussion is well arranged and illustrated by figures which are sufficient in number and variety, but are of a size which demands a reading glass or a microscope for the examination of the details. The chapter on liquid fuels shows too much foreign influence. Among ten carbureters that are figured there surely should have been one good example of an American make of float-feed spraying carbureter. It is also observable that alcohol vaporizers, which are not used at all in this country, occupy more space than gasoline carbureters, of which tens of thousands are in use.

The subjects of the explosibility of fuel mixture, of the pressures and temperatures resulting from explosion and of the time of explosion are handled rather more briefly than their importance demands. The most notable omission is the lack of all reference to the recent work of Nägel on the velocity of explosion. Nägel's work is so definitely superior to all that has gone before it that it practically makes the other work obsolete.

The discussion of modern types of internal combustion engines occupies 130 pages, and is illustrated by the same number of figures. These figures are for the most part extremely poor—often they are undistinguishab'e dirty smudges. This is the one serious blemish in this book. The line drawings are sometimes fair, but the reproductions of photographs are uniformly poor. An illustration has no place in a text-book if it does not illustrate. It is above all things necessary that the figures should be well chosen and well reproduced. Neither is the case in this chapter. The arrangement, also, is unsatisfactory. It is an arrangement, based on the engine builders instead of on the engines and reads

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very much like a collection of trade catalogues. It is not well to incorporate in text-books the information that certain firms located in certain places make certain types of engines up to certain sizes. If the matter had been systematically arranged with a view to comparative study of the parts and arrangement of engines and had been adequately (rather than copiously) illustrated it might have been valuable and instructive; as it is, it is of but little use.

The parts of the book dealing with ignition, regulation, the estimation of power, the results of tests and the costs of instal'ation and operation are up to the high standard of the earlier chapters.

Altogether this book may be highly recommended to students and engineers. It covers its chosen field more thoroughly and more capably than any other book in the English language, and it appears to be remarkably free from inaccuracies. The only respect in which it is seriously lacking is in its failure to handle satisfactorily the subject of gas-engine construction.

British Ideas on Sewer Ventilation.

THE VENTILATION OF PUBLIC SEWERS.—By John S. Brodie, M. Inst. C. E., F. R. S. I., etc. London, England: The St. Bride's Press, Ltd. Cloth; 5½ × 9 ins.; pp. 170; 25 illustrations in the text. 6s., net; American price, $2.40.

It is not quite easy for American engineers to understand why their British cousins should have such interminable discussions over the ventilation of sewers. At least this cannot be understood except on the assumption that a large percentage of the British sewers are so old and poorly constructed that the deposits in them are more voluminous and troublesome than are those in American sewers. Perhaps it should be noted in addition that a large percentage of British sewers are on the combined plan, and that the dry-weather sewage is much more concentrated than that in this country, owing to the relatively small water consumption in Great Britain. Of course it might be assumed in addition that the British public and municipal authorities are more sensitive to any ill effects that may come through a lack of sewer ventilation, than is the case in America. We think, however, that the main difference lies in the defective condition of British sewers and the concentration of sewage.

Those interested in what British engineers and medical officers of health have said and done about sewer ventilation, will find the volume before us a convenience. It is mainly a compilation. The first half is a fairly systematic arrangement of digests of society papers and discussions, and municipal reports on sewer ventilation, accompanied by comments by Mr. Brodie. The first part also includes illustrated descriptions of a number of systems of sewer ventilation. A considerable percentage of these systems are so discredited by the author, or so evidently useless, that their inclusion could only be warranted by a desire to make the book complete. In a chapter of eight pages, toward the end of Part I., the author submits a comparison of costs of the various systems of ventilation now in use, going into a fair amount of detail. A tabular summary shows that the first cost of these systems ranges from £50 to £1,233 per mile of sewer ventilated (about $200 to $6,000), while the annual cost, including capital charges and operation, ranges from £11 to £151 (about $55 to $750). The higher costs are for Shone & Ault's "hydro-mechanical system of sewer ventilation," some description of which was published in Engineering News of Nov. 24, 1904.

The second part consists wholly of abstracts of the literature just mentioned, chronologically arranged. These abstracts include the opinions of many engineers and other municipal authorities, as expressed in discussions and in the tabulated results of various circular inquiries. A great diversity of opinion is shown on nearly every point raised, except as to the frequent necessity of stopping up ventilated manhole covers, and where this is done providing ventilating columns. These columns sometimes serve to support lamps, sometimes are relatively large, independent stacks, but most commonly of all are attached to buildings.

A few of those quoted are bold enough to say that it is inadvisable to attempt any sewer ventilation whatever. But these are decidedly in the minority. A fair number, but still small in comparison with the total of those whose opinions are recorded, would like to see main traps omitted and the lateral sewers ventilated through house connections and soil pipes. It should be explained here that as a rule the British sanitary authorities are not satisfied with the ordinary running trap alone, which is common in this country where trapping is required, but insist on a disconnecting trap which is virtually a combination of a running trap and a manhole or air chamber.

The book as a whole is well presented, from the publisher's viewpoint, and assuming that there is a real need for an extended work on sewer ventilation the author is to be commended for the way in which he has brought together the most important of the available British information on the subject. There are scarcely any references to sewer ventilation in other countries, nor does the author serve his readers to any great extent by a scientific exposition of the real principles which should govern the design and operation of sewer ventilation. For the most part, he simply presents what others have written or done in this line, with a few words of comment now and then and a brief summary review of the leading "systems" of sewer ventilation described. The general viewpoint seems to be that engineers will make a selection from some of the "systems" described instead of working out their own scheme, in accordance with the fundamental principles and the local conditions involved.

Steam Power Plants.

STEAM POWER PLANT ENGINEERING.—By G. F. Gebhardt, Professor of Mechanical Engineering, Armour Institute of Technology, Chicago, Ill. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 816; 461 illustrations, mostly in the text. $6, net; English price, 25s. 6d., net.

Professor Gebhardt has taken up in detail all that relates to the development of power with the steam engine (or turbine) as a prime mover, with the exception that he has not touched on the actual design of boilers and engines—work which nowadays is not in the hands of the power-plant designer. No attempt has been made to go farther than the prime movers themselves. It will be recognized at once that, even with such limits, the field of the book necessitates a volume approaching the limit of size and price for broad circulation.

The author takes up his subjects in a typical lecture-course sequence, which will appeal to those familiar with such methods. Elementary plants of the simplest condensing and non-condensing types and those with all the usual heat-saving appliances are described with the aid of diagrams. This forms the introduction and carries out the definition of the essential parts of a steam power plant from the coal pile to the fly-wheel. The words or phrases which it is desired to define or to specifically draw attention to are italicized. This scheme is carried through the book, though naturally most marked in the early parts. After the preliminary parts, the details of good practice and acquired knowledge of performance are assembled in groups—each group forming a chapter, and the progression of subjects being from the fuel forward through boilers, furnaces, superheaters, coal and ash-handling machinery, chimneys, mechanical draft, engines, turbines, condensers and feed-water apparatus. After these, is a chapter giving typical specifications for an engine, a boiler, a condensing outfit, a piping system and for the purchase of coal. Two more chapters describe typical turbine and reciprocating-engine plants. The final 75 pages forms six appendices and includes a bibliography of the more recent articles on power-plant engineering, including gas and hydraulic work as well as steam, and in most cases related to the generation of electricity. The codes of the American Society of Mechanical Engineers for boiler and engi[ne] here, with a table of the propert[ies] rated steam (from Peabody's Table[s] tables of conversion factors and values of mechanical and electrical

At the end of each subdivision of a brief catalog of technical artic[les] more extensively that particular su[b]discussion. Theory and practice hand in hand through the book. A vast amo[unt] is given in tables and curves represe[nting] tests and trials, many of which [were] made at Professor Gebhardt's own [school], the Armour Institute of Technology. Bu[t slight] verse criticism can be made on the [book], and that only in a few minor details. T[he] cifically the care and completeness [with] the author seems to have selected and [arranged] his material would be impossible her[e]. It can be hinted at, however, by runnin[g] couple of chapters briefly.

"Fuels and Combustion" is the secon[d] chapter of the book. The first more general matter consists of classifications and descriptions of typical fuels and is interspersed with lists of articles printed by the technical press. The theory of combustion and combustion temperatures, of the various losses in burning coal are briefly discussed, and after these the proper purchase of coal by specification. Much attention is paid to powdered, liquid and gaseous fuels and to systems for burning them. Each subdivision of these topics is accompanied by references for further reading and study.

In the chapter on steam engines, in another part of the book, the author presupposes considerable knowledge of thermodynamics and starts his review of ideal conditions by quoting Carnot-cycle formulas. Actual mechanical and thermal efficiencies obtainable are discussed with the various classes of engine losses. The practical effects of increased steam pressure, of receiver-reheating, of jackets are shown by results of tests. Then follow brief descriptions of types of engines in actual use—single and double-acting, simple, compound, triple and quadruple-expansion, high and low speed, simple and multi-valve. The practical effects of condensing, superheat, cut-off point, etc., are shown by tabulated data. A few paragraphs take up binary-vapor engines.

The whole work seems modern, comprehensive and reliable and, while professedly prepared for students, it should serve as a good memory aid for the older engineer and a guide for the younger. Its bibliographies alone make it a valuable reference.

An English Work on Hydraulics.

Reviewed by GARDNER S. WILLIAMS,* M. Am. Soc. C. E.

HYDRAULICS AND ITS APPLICATIONS.—By A. H. Gibson, Assoc. M. Inst. C. E., Senior Demonstrator and Assistant Lecturer in Engineering in the University of Manchester. New York: D. Van Nostrand Co. Cloth; 5¾ × 9 ins.; pp. 757; 310 illustrations in the text. $5, net.

The author states in his preface that "an attempt has been made to consider the science, and its application to the design of hydraulic machinery, in a manner suitable for a student who has some initial knowledge of mechanics," and those who approach the subject with no more preliminary training than is assumed by the ordinary American text-book writer on hydraulics will soon find themselves beyond their depth. The book stands in much the same relation to the works of Merriman and Church that Cotterill's does to the ordinary treatises on mechanics.

After a very brief outline of the history of the science, the physical properties of water are taken up and cohesion, adhesion and viscosity are treated with considerably more detail than ordinarily. This discussion, though brief, presents clearly the fundamentals of the matter and reference is made for more exhaustive treatment to the monograph on capillary action in the Encyclopaedia Britannica and to the Philosophical Transaction of the Royal Society.

The second chapter deals with the Hydrostatics and its application to masonry dams; flota-

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tion an[illegible]illation of ships and the strength of pipes [illegible] thick cylinders and a discussion is present[illegible] of the vertical shear in dams and retaini[illegible] walls with references to the recent contri[illegible]s on the subject by Atcherly and Unwin, [illegible]ich is followed by an analysis of the time o[illegible]illation of a rolling ship.

Chap[illegible] III. begins what is known as Section II [illegible] the book under the general head of Hydra[illegible]s and opens with a resume of the color-[illegible] experiments of Osborne Reynolds and [illegible] Shaw, followed by a description of vortic[illegible]otion, but the analytical treatment is omitte[illegible]nd the reader referred to the work of Hicks [illegible] the Philosophical Transactions. Straight line an[illegible]eddy motions, the critical velocity, and the e[illegible]cts of viscous resistance follow naturally, the last being treated analytically.

In Chapter IV. is presented the theoretical mechanics of Hydraulics and the equations of motion for a viscous fluid are derived and applied to stream line flow, following which is presented a comprehensive demonstration of Bernoulli's Theorem by the method of equation of forces, there being a marked distinction here from the ordinary demonstrations by this method, that account is taken of all the forces. The application to the Venturi meter, to sudden enlargement and contraction, curvature and vortex motion with some original experimental data, complete a chapter which for one who is rusty upon his mechanics will be found hard reading, but which is to be highly commended as an intermediate step to the works of Stokes and Lamb. In the following chapter the flow through orifices is presented in one of the most satisfactory discussions on the subject in English, except that the influence of suppression of contraction is neglected and the case of partially submerged discharge is treated by the old Du-Buat method. From the quality of the preceding work the reviewer was led to hope that a more rational treatment of this case and of that of submerged weir would be developed. The discharge over weirs and through notches is treated, but with less analytical completeness, and with a misconception of the influences of flat crests. There are also some unfortunate errors in the citations of experimental data.

The comments on the "use of the weir as a water measuring apparatus" indicate a considerable lack of experimental knowledge on the part of the author, as for instance when he states that in a rapidly moving stream "the hook gage is the only suitable appliance" (for reading head). Anyone who should attempt to use the hook under these conditions would at once discover the impossibility of even approximate work with it.

Chapter VI. is devoted to fluid friction and its applications to naval architecture, the investigations of Froude forming the foundation; and Chapter VII. to pipe flow. The derivation of the Reynolds equation and of the limits of the critical velocity is presented and an analysis is given of the several formulas, particularly those of Reynolds, Unwin, Lawton, and Thrupp, which is to be commended to those wishing to inform themselves upon the real rather than the assumed laws of flow; but in an examination of experimental data the author again shows his lack of appreciation of practical conditions, and the references to the publications of the American Society of Civil Engineers appear to be indiscriminately to Transactions and Proceedings under the former title. Furthermore some of these references seem to have been quoted or copied from other than the original documents. A considerable space is devoted to the mechanics of the stoppage of flow and water hammer.

The hydraulic gradient and the losses in pipe lines are quite comprehensively treated in the following chapter, but the opportunities which the subjects offer for mathematical investigation are largely overlooked.

In the flow in Open Channels, Chapter IX., the empiric formulas of Prony, Eytelwein, Darcy and Bazin, Kutter, and Manning are first discussed and then the more rational ones of Fidler and Thrupp. The characteristics of various forms of channel are examined, the general equation of flow is derived; non-uniform flow is investigated and the general problem of back water presented; the latter analysis being much more extensive than is usually attempted, but its practical utility is limited by being confined to the case of uniform width. The influence of bridge piers and the passage of boats through narrow channels are considered, and the distribution of velocity in open channels is then taken up, but the author has apparently overlooked the main points of the Bazin analysis of the problem and just misses a rational solution of the case, reaching instead the old Darcy equation of the parabola. In his discussion of erosion and deposition he very correctly observes "The tendency to deposition of silt, however, depends more upon the changes of velocity in the stream than upon the actual velocity," a statement that long ere this should have been in every text-book, but which in print is really a novelty. The chapter closes with the Gaging of Flow in Open Channels, and in advising the use of the hook gage in the middle of a flowing stream. The author again shows his lack of experience in the field, as well as when he speaks of gaging by current meter with the instrument fastened to a post driven into the bed of the stream, and he attaches to the meter too much accuracy, failing apparently to see that it is much more susceptible to the influences he describes as operating against accuracy in float gagings.

Chapter X. begins with Impact of Jets and gives some experimental data by the author on the pressures exerted on various formed vanes. The distribution of pressure over flat plates, and the action of the ball nozzle are examined and jet propulsion is discussed, as well as rudder action and the resistance of submerged bodies.

Chapter XI. begins Section III., but the fact is only discoverable by reference to the Table of Contents, as the printer has omitted to indicate it in the heading of the chapter. This section is devoted to hydraulic machinery and opens with prime movers, describing in the first two chapters the ordinary types of wheels. The discussion of the American or mixed flow turbine is unfortunately confined almost wholly to the data found in the trade literature of a single manufacturer. The following chapter deals with the theory of turbine design, and Chapter XIV. is devoted to hydraulic engines. Chapter XV. offers as valuable discussion of reciprocating pumps, and Chapter XVI. of the centrifugals. The hydraulic ram, jet pump, air lift, and hydraulic air compressors are the subject of Chapter XVII. Chapter XVIII. covers hydraulic power transmisson and the related apparatus, together with water meters in which latter the American types, except the Venturi, are entirely omitted. Chapter XIX. completes the book and presents hydraulic lifts, cranes, presses, riveters, brakes, and lastly the hydraulic dynamometer developed by Froude and Reynolds.

Typographically the book is well made up, but the paper is extremely heavy. The book, which contains 772 pages, weighs 3½ pounds, while the bound report of the Massachusetts State Board of Health containing 774 pages of the same size, weighs less than 2½ pounds. This excessive weight all too common in the present output of our publishing houses is a decided objection with the student who may have to carry three or four volumes at a time.

The subject matter is not handled with uniform discretion, some parts being excellent and others rather loosely thrown together, and the language in places is that of a lecturer rather than of a writer, and, worst of all, the citations of experimental data are not always accurate. In the hands of an instructor familiar with experimental limitations the work will be a useful text for advanced students, and will do much to improve the exactness of hydraulics as a science if it become generally studied, but it is a little too advanced for most of the students in our American schools.

The Resistance and Propulsion of Ships.

Reviewed by D. W. TAYLOR.*

HYDRAULICS.—By S. Dunkerley, M. Inst. C. E., M. Inst. M. E., Professor of Civil and Mechanical Engineering in the University of Manchester and Director of the Whitworth Laboratories. In two volumes. Vol. II.: The Resistance and Propulsion of Ships. London, New York and Bombay: Longmans, Green & Co. Cloth; 5⅛ x 8⅛ ins.; pp. 253; 115 illustrations in the text. $3; English price, 10s. 6d., net.

Although this is Vol. II. of a work on Hydraulics, it is complete in itself, Vol. I.† having to do with hydraulic machinery. This book is founded upon and evidently follows closely Professor Dunkerley's lectures on the resistance and propulsion of ships when he was a member of the staff of the Royal Naval College at Greenwich, England.

Chapter 1 of 31 pages deals with stream lines; chapter 2 of 45 pages with waves; chapters 3 and 4 of 61 pages in all with resistances of all kinds, the law of comparison, etc.; chapter 5 of 29 pages with the features affecting the resistance of full sized ships; and chapter 6 of 80 pages with the theoretical considerations affecting the propulsion of ships. The index occupies 7 pages.

In discussing stream lines, the author gives a little elementary hydrodynamics and something about sinks and sources. Plane stream lines past a circular cylinder are discused quite fully, Rankine's methods being closely followed. This chapter is concluded with condensed information about the stream lines around a sphere and Hele-Shaw's experiments in connection with plane stream lines.

Under waves, the author gives a condensation of Scott-Russell's work on waves of translation and brief deductions of the well-known formulas for trochoidal waves in deep and shallow water, concluding with some account of capillary waves. In dealing with trochoidal waves he follows closely Rankine's methods.

In considering ship resistance the author separates it as is customary into the three components, eddy resistance, skin resistance and wave making resistance. In connection with eddy resistance he gives a number of the more or less contradictory formulas which have been obtained by various experimenters, but does not assume to fix that which is most correct or reliable.

Under surface friction he gives the well-known Froude results. His statement, however, on p. 85 that "The only reliable experiments on surface friction are those by Mr. William Froude" is hardly warranted. Tideman's experiments, made very soon after Mr. William Froude published his results, are certainly reliable.

On p. 91 is found a table of frictional coefficients which the author states to have been given by Mr. R. E. Froude. While this table can be deduced from data in papers by Mr. R. E. Froude, it was not given directly by him. Incidently, it may be remarked that in the table the coefficient "f" for a length of 100 ft. is erroneously given as 0.00913. It should be .00923.

In dealing with the law of comparison, the author gives the demonstration based upon the steady motion formula, and in exemplifying the law he abstracts Mr. Froude's paper of 1874 before the Institution of Naval Architects on the Greyhound experiments.

There is nothing novel in the author's treatment of wave making resistance, the figures and data of tests given being taken from papers by the elder and younger Froude, and the general treatment follows closely well known lines developed by them.

In Chapter 5, which has the not very happy title "Trials on Full Sized Ships," the author gives a good deal of rather heterogeneous data taken almost entirely from papers before the Institution of Naval Architects. In this chapter would naturally be given methods for estimating resistance and power of ships. What little is given in this connection, however, is of practically no value for the purposes of the designer.

*Naval Constructor, U. S. N., U. S. Navy Yard, Washington, D. C.

†Reviewed in Engineering News, Dec. 12, 1907, p. 650.

In Chapter 6, dealing with propellers, the author, after giving some of the general considerations affecting ship propellers, gives at some length Rankine's, Greenhill's and William Froude's theories of propeller action and also R. E. Froude's reasoning in this connection. He gives the experimental results with models obtained by R. E. Froude and published by him in papers before the Institution of Naval Architects in 1886 and 1892. He concludes with some remarks on cavitation and gives interesting figures from Mr. Parsons showing small model screws cavitating. In connection with cavitation, the author accepts the Barnaby rule laid down a good many years ago that the limiting average pressure which can be permitted per square inch of projected blade area is 11¼ lbs. This limit was deduced by Barnaby from experiments of a limited range and while applicable to a particular type of vessel and propeller, experience has shown it to be entirely unreliable as a general rule. Cavitation has been found where the pressure was far below the 11¼-lb. limit—less than half in some cases where the blade section and tip speed were such as to induce cavitation.

This book has a great many typographical errors, such as on p. 56, fifth line from bottom, "observing" instead of "obscuring;" on p. 65, eighth line, "many" instead of "may;" on p. 110, about half way down, "7,540 tons" instead of "1,160 tons;" on p. 142, near the bottom of the first paragraph, "1.00 I. HP. per ton" instead of "10.00 I. HP. per ton." In the table on p. 186, the heading of the second column is evidently erroneous, but it is impossible to say what is meant. In note 2 on page 222 "inward" is used, when "outward" is meant. In the table of errata the author has corrected the typographical error on p. 140 where the displacement of the vessel is given as "93,000 tons" instead of "9,300 tons," but it would be advisable to make a change here to bring the data within the limits of possibility. In illustrating the departure of skin resistance from the law of comparison the author assumes the case of a vessel 345 ft. long of 9,300 tons displacement and 23.7 knots speed. No vessel of this length and displacement has ever developed such a speed.

This work is essentially a compilation of papers on its subject which appeared before the Institution of Naval Architects and other British technical societies up to 1900. The author appears to ignore papers in other countries and includes no British papers on his subject subsequent to 1900, although there have been a number of such. In connection with model propeller experiments the author gives no data subsequent to 1892.

For the purposes of a designing naval architect and engineer this book is of small value, since it contains so little that is practically applicable to the problems arising in practice. To the student who does not have access to transactions of the Institution of Naval Architects it will be of some value. For the purposes of the ordinary student the treatment of plane stream lines around a cylinder and of waves of translation is quite as adequate as the original papers by Rankine and Scott Russell. Scott Russell's works are not accessible to most students.

In this connection the author's statement on p. 34 that Mr. Scott Russell "was the first to make experiments on waves" needs some qualification. Scott Russell was probably the first in England to make experiments on waves, and very probably the first in the world to make exhaustive and reliable experiments on waves of translation, but Scott Russell's investigations were published in the British Association reports for 1837 and 1844. In 1825 the Weber brothers published in German an elaborate work on waves giving results of many experiments made by them. They dealt mainly with oscillating waves and their experiments were not so reliable as those of Scott Russell on waves of translation, but they were very extensive and afforded a great deal of information on the subject of wave motion.

A Correspondence School Cyclopedia of Civil Engineering.

CYCLOPEDIA OF CIVIL ENGINEERING.—A General Reference Work on Surveying, Railroad Engineering, Structural Engineering, Roofs and Bridges, Masonry and Reinforced Concrete, Highway Construction, Hydraulic Engineering, Irrigation, River and Harbor Improvement, Municipal Engineering, Cost Analysis, etc. Editor-in-Chief, Frederick E. Turneaure, Dean, College of Engineering, University of Wisconsin; Assisted by a Corps of Civil and Consulting Engineers and Technical Experts of the Highest Professional Standing. Eight Volumes. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 3,362; numerous plates and text illustrations. The complete set, $24.

The Cyclopedia of Civil Engineering, like its predecessors, the Cyclopedia of Applied Electricity and the Cyclopedia of Architecture and Building*, is a compilation of various instruction books issued for students by the American School of Correspondence. These books, each treating some especial branch of civil engineering, have been originally printed separately in the same style of typography, and are brought together in eight uniformly bound volumes, each paged both for the volume and the individual paper, and copiously interleaved with half-tone cuts which may or may not have anything to do with that particular part of the book in which they are placed. Each of the separate papers is the work of some well-known practicing engineer or engineering professor who, in most cases, is fully competent to write upon the subject of his volume. Indeed, in many instances the authors have already published books, to which the present papers bear a remarkable resemblance.

As separate texts we have already reviewed many of the books included in the Cyclopedia, at these times commenting upon them purely for what they purported to be, correspondence school text-books, by means of which, with the occasional aid of explanatory papers, the home-student could get some knowledge of the principles of engineering. However, a somewhat different viewpoint in the estimate of the assembled volumes is necessitated by the following extract from the Cyclopedia.

> The marvelous developments of the present day in the field of civil engineering . . . have created a distinct necessity for an authoritative work of general reference embodying the results and methods of the latest engineering achievement. The Cyclopedia of Civil Engineering is designed to fill this acknowledged need.
>
> The aim of the publishers has been to create a work which, while adequate to meet all demands of the technically trained expert, will appeal equally to the self-taught practical man, who, as a result of the unavoidable conditions of his environment, may be denied the advantages of training at a resident technical school.

This assumption that text-books for home study, when brought together under one binding, may form a reference book for the practitioner, is based on a faulty or at least incomplete conception of the function of the two. A text-book is used as the adjunct of personal instruction in acquiring knowledge afterward to be used in practice; a reference book is for the occasional aid of the practitioner, versed in the general processes of his profession, to recall forgotten details or to supply omitted ones. In the higher classes of text-books, those which treat of the principles of the profession, the elements of pure and applied science are expected of the student, and the books are so written that they can be used in practice as reference books. In elementary works, on the other hand, where the author is attempting to lead a reader from entire or at least partial ignorance of the subject into a fairly complete knowledge, the methods of developing the theme must be so elementary and gradated that the book can be available for nothing but initial instruction. The steps taken must be so minute and the explanations so explicit that the book will be of little value as a future reference once the elements of its matter are well grounded.

Especially is this difficulty inherent in the text-books of the correspondence schools, books intended for entirely written instruction which must be so clear and so elemental that, in a way, they replace the personal element of the instructor assumed by the ordinary text-book. As a result of this necessity for a clear exposition of every statement they must omit many important but involved portions of the subjects, partly from lack of space and partly from the very complication of demonstrations which cannot be expressed in terms understandable by the student who has not had the benefit of personal explanation of certain parts or passages. This effort to make the subject matter to the elementary student gives to necessarily the papers in this Cyclopedia a superficial character. They glide lightly and easily over some of the most important descriptions and theories because the space is lacking and the pupil has not been prepared to comprehend the necessarily involved discussion. As the text-book for the home student we can imagine that the Cyclopedia will have a valuable place, although the separate volumes might serve his purpose better, for in the Cyclopedia he has to take the good with the bad. But to the practicing engineer we cannot see that the collected volumes will serve any useful purpose. With the possible exception of one or two papers every subject has been treated more thoroughly and more fully more broadly than in these text-books.

The individual papers are too many for a separate estimate to be made in this review; some have already been reviewed in the past as separates; it is probable that the others will be so treated in the future. The titles in the eight volumes are as follows:

V. 1, Plane Surveying, Alfred E. Phillips; Mechanical Drawing, Erwin Kenison.

V. 2, Plotting and Topography and Railroad Engineering, W. L. Webb.

V. 3, Strength of Materials and Statics, E. R. Maurer; Roof Trusses, Frank O. Dufour; Cost-Analysis Engineering, R. T. Dana and H. P. Gillette.

V. 4, Masonry and Concreting Materials, W. L. Webb and W. H. Gibson; Stone Masonry and Plain Concrete Construction, W. L. Webb and W. H. Gibson; Reinforced Concrete, W. L. Webb and W. H. Gibson.

V. 5, Steel Construction, E. A. Tucker; Practical Problems in Construction, S. F. Strickland and C. H. Rutan.

V. 6, Bridge Engineering, F. O. Dufour; Highway Construction, A. T. Byrne and A. E. Phillips.

V. 7, Water Supply, F. E. Turneaure; Irrigation Engineering, A. E. Phillips; Sewers and Drains, Anson Marston; Plumbing, W. B. Gray and C. B. Ball.

V. 8, Water-Power Development, Adolph Black; River Improvement, Charles E. Morrison; Harbor Improvement, Charles E. Morrison.

BRIDGE ENGINEERING.—ROOF TRUSSES.—A Manual of Practical Instruction in the Calculation and Design of Steel Truss and Girder Bridges for Railroads and Highways, Including Also the Analysis and Design of Roof Trusses and Other Details of Mill Building Construction. By Frank O. Dufour, Assistant Professor of Structural Engineering, University of Illinois. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 254 + 96; plates and numerous text illustrations.

Of the many contributions to the Cyclopedia of Civil Engineering noted elsewhere on this page, the book on bridge and roof design by Prof. Dufour is among the best.

Under each of the two parts—Bridge Engineering and Roof Trusses, separately paged as taken from two different volumes of the Cyclopedia—it takes up the computation of stresses and the practice of detailing. Stresses are treated entirely analytically, except in a few instances, where graphic diagrams are printed with no other explanation than a reference to a vaguely indicated companion volume. For such an exposition of the theory of stresses as a new student requires—simple, clear and consecutive—the book is satisfactory. It suffers somewhat from its association to the Cyclopedia, in its references to other parts of the larger work to which the reader may not have access, but these references are mostly to higher structures or more intricate theory which the volume at hand does not pretend to treat. As indicated by the subtitle (though not by the main title) the steel structure alone is taken up in the discussion of details; under bridges there is no attempt to discuss masonry, and under roof trusses there is no reference to timber details.

For its intended use as an introduction to the study of bridge design it surely has a place, though it can in no way replace the more widely known standard books on the same subject.

*Reviewed in Engineering News, March 16, 1905, and Dec. 12, 1907, respectively.

Books on Railway Track.

Reviewed by JOHN F. WALLACE,* Past-President Am. Soc. C. E.

RAILWAY TRACK AND TRACK WORK.—By E. E. Russell Tratman, Assoc. M. Am. Soc. C. E., Associate Editor "Engineering News." Third Edition, fully revised and enlarged. New York: The Engineering News Publishing Co. London, England: Archibald Constable & Co. Cloth; 6 × 9 ins.; pp. 520; 250 illustrations in text, and 4 large folding tables. $3.50, net.

ELEMENTS OF RAILROAD TRACK AND CONSTRUCTION.—By Winter L. Wilson, Professor of Railroad Engineering, Lehigh University. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. 320; 181 illustrations in text. $2; English price, 8s. 6d., net.

Mr. E. Russell Tratman's work on "Railway Track and Track Work" not only treats this subject in an exhaustive and comprehensive manner, but provides a most valuable addition to the literature on American railway track, which, of all subjects bearing on railroad problems, has been the one most deficient in that respect.

American railway engineers who are still young can well remember the interest with which the pages of Charles Latimer's "Roadmaster's Guide" were first read, it being, if the writer remembers rightly, the first crystallization in book form of the literature on practical track work.

In later years this was followed by William Barclay Parsons' book on "Track," and track men generally felt that Mr. Parsons should have revised and re-issued this work from time to time, as it supplied a growing want upon the part of engineers and practical railroad men.

It is certainly gratifying to the members of the engineering profession to know that Mr. Tratman has taken it upon himself to keep pace with the constant development in track work, and to continue to devise his admirable work from time to time as the addition of new material may be necessary.

Outside of the official publications of the American Engineering and Maintenance of Way Association, there is no single work which contains between its covers such a broad and comprehensive treatment of the subject; and it is a work which should certainly be appreciated, not only by members of the engineering profession who make a specialty of track work, but by every practical railway man and official whose duties require him to come in touch with maintenance-of-way matters.

Mr. Tratman's work will assist in giving dignity to maintenance-of-way work, and, taking it out of the field of ordinary skilled labor, place it on the higher plane of professional engineering accomplishment.

The thanks of the engineering profession are certainly due to Mr. Tratman for his efforts in this direction.

The "Elements of Railroad Track and Construction" by Winter L. Wilson, shows a fine and discriminating appreciation of the best, most effective and interesting way to bring before engineering students the salient principles of railway track and maintenance-of-way work.

Professor Wilson has treated this matter in a very attractive and common sense manner, and has produced a work which should be admirably adapted for the purpose of a standard text-book upon this subject for young engineering students. He has certainly shown the qualities of a high-class instructor by presenting his subject in plain and simple language, unincumbered by complicated or unnecessary mathematical formulas, and it is written in such a way as not only to interest young engineering students in this subject, but to impress upon their minds the essential principles underlying maintenance-of-way work.

It is to be hoped that those for whose benefit this work is published will appreciate it, and that the first edition may be followed by many others.

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Boiler Accessories.

BOILER ACCESSORIES.—A Complete and Authoritative Treatise on the Various Accessories of the Boiler Room and Engine Room Essential to Economical Operation, together with Practical Instruction in Their Use. By Walter S. Leland, Assistant Professor of Naval Architecture, Massachusetts Institute of Technology. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. 123; plates, and 72 text illustrations. $1, net.

The title "Boiler Accessories" is liberally interpreted, for space is given to boiler supports, settings and furnaces and to capacity, corrosion and incrustation, explosions, fuels and trial conditions. There is the expected matter on fittings, draft systems, pumps, injectors, feed-water purifiers, moisture separators, calorimeters, piping, etc. The book seems to well serve its purpose of a not-too-technical manual of boiler appurtenances. There are but few trade-catalogue cuts; the most of the diagrams appear to be from original drawings arranged to show the main ideas clearly and simply.

In one place the author is apt to create an impression which must be contrary to his teachings, for the point is partly controverted later. On page 2 we read:

> The space between the bridge and the shell is from 6 to 8 ins., which brings the hot gases into close contact with the boiler before they enter the combustion chamber beyond.

It is generally conceded that, for economical and smokeless operation, the hot gases are not to be brought into contact with cold metal until combustion is completed. This very point is given on page 9. The unwarned student, however, could scarcely be expected to know that a high bridge wall was often a good preventive of such desired combustion. Indeed, some practicing mechanical engineers require that the bridge wall serve merely as a fuel stop. The heat is to be absorbed largely in the tubes, for these form about 90% of the heating surface of the fire-tube boiler discussed. No appreciable advantage is claimed for making the gases hug the shell at the bridge wall.

On page 14, where the author states that

> actual loss caused by the escape of smoke, even when it is dense and black, has been found to be slight,

it would have been better to explain that while the actual loss by the carbon seen in smoke was small, it was a nearly infallible sign of accompanying escape of unburned gases giving a bad drop in efficiency of combustion.

Mechanical stokers are passed over with some 350 words, which seems a bit inadequate.

Early in the book the author advises placing the boiler with the hand-hole end about an inch lower than the other end. This practice is now condemned by some good practicing engineers on several grounds. First, they prefer a level boiler for ease in fitting flanged connections; again, they claim that the circulation is usually from the hand-hole along the bottom of the shell and that a small fall of 1/16-in. per ft. will not cause the sediment to pass toward the hand-hole against the current.

STRENGTH OF RIVETED JOINTS.—By J. W. Rausch, Superintendent Inspection Division, Maryland Casualty Co. A lecture delivered at an open meeting held under the auspices of Euclid Council No. 14, Universal Craftsmen Council of Engineers, Baltimore, Oct. 29, 1908. Baltimore, Md.: Maryland Casualty Co. Paper; 6 × 9 ins.; pp. 12.

Contains an explanation of how to compute the strength of riveted joints, both lap and butt, with single or multiple riveting; it is written so as to be easily understood.

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Hydro-Electric Practice.

Reviewed by F. C. FINKLE.*

HYDRO-ELECTRIC PRACTICE.—A Practical Manual of the Development of Water Power, Its Conversion to Electric Energy, and Its Distant Transmission. By H. A. E. C. von Schon, M. Am. Soc. C. E., Civil and Hydraulic Engineer. Philadelphia and London: J. B. Lippincott Co. Cloth; 7¼ × 10 ins.; pp. 382; 140 illustrations, mostly in the text, 40 diagrams and 33 tables. $6, net.

If the prospective reader of this work expects, as the title indicates, that it is a manual of practice in hydro-electric development, he will be greatly disappointed. Without wishing to detract from the value of the book, so far as it goes, it is correct to say that the title is misleading. The work is really an elementary treatise, covering only a limited part of the field of hydro-electric practice in the United States.

Without further special reference, this point will become sufficiently clear in the comments to follow.

The arrangement of the matter is in proper logical sequence. The discussion opens with a statement on market requirements for a commercial development, giving an illustration, which is far from complete and convincing. Any such research should include data showing the cost of the power per kilowatt hour or horse-power hour, both from the old plants, and from the proposed hydro-electric development intended to replace them. Only in this way can conclusions as to probable revenue be reached with any degree of certainty.

In Chapter 2 the treatment of the available water supply from streams purports to be general, but the rules laid down apply only to the eastern part of the United States and to other regions, where the quantity and distribution of precipitation are the same as there.

This chapter is very disappointing in one other regard; as it fails to indicate any rules by which the supply of water may be determined, if regulated by means of reservoirs of a given capacity. This is a most important problem on streams having radical monthly, annual and secular fluctuations in their discharges.

The list of rivers given in Table 1 is of much value for reference, although the low flow given is, in many cases, based on insufficient information, and therefore the figures are unreliable. Great care was not used in preparing the list, as many important rivers are omitted, as, for instance, the Cache a la Poudre, which is the second largest river on the eastern slope of the Rocky Mountains in Colorado and the Sandy in Oregon, which drains the western slope of Mount Hood, the highest mountain in Oregon, and is an important tributary of the Columbia near Portland, while many less important streams are included.

Chapter 3 should have had reference to many important matters affecting the investment of capital in hydro-electric projects, among which may be mentioned the status of such undertakings on National Forest Reservations, which now include some 160,000,000 acres of public land and most of the mountain streams with undeveloped water power in the United States. Also the matter of acquiring water rights for power both under State and National laws and from vested interests should have formed an important part of this chapter.

The data given in Chapter 4 relating to costs is well presented. It is both accurate and valuable as relating to the region of the Middle West adjacent to the Great Lakes but, with the exception of the diagrams for arriving at quantities, has little application elsewhere.

Chapter 5 is devoted to showing how hydro-electric projects should be presented in the form of an engineering report. Whatever the opinion of the author, it is safe to say, that the method outlined is not now regarded as the most complete and satisfactory one for making such a presentation. The most advanced hydro-electric engineers seem to prefer graphical demonstrations and presentations, both because they are less confusing than figures, and therefore more easily grasped by others, and also because they condense the information.

Aside from this, the example chosen is an unfortunate one, because it is insignificant in character and too simple to serve as a model, when large and important projects, involving the usually complicated features accompanying them, are to be reported upon.

Chapter 6 is a very complete exposition of the surveys and other preliminary investigations required before planning a project. It is not general, however, and can only be said to apply in its entirety to the eastern part of the United States. Even there some classes of projects, which require extensive storage capacity, have high heads or are located on streams, where the water is already employed for some other purpose, require a variety of investigations not mentioned. Much of the rudimentary instruction in surveying, topography, etc., might well have been omitted, and the space it occupies devoted to more important subjects not so readily accessible in other books.

The matter in Chapter 7 is presented in better form than that in any other part of the work. Were it not for the failure to treat more in detail the so-called "Distant Diversion Developments" shown in Plans 14, 15 and 16, there would be nothing further to wish for.

As a matter of fact most all opportunities for a direct development, or one quite near the diversion point, have been utilized. Those remaining nearly always require long feeder conduits, terminal regulating reservoirs, etc., which present many difficult and engrossing problems to the hydro-electric engineer. Hence a complete presentation of this would have been very valuable, particularly as it is not now available in any other book.

In Chapter 8 the treatment of coffer dams, the back water curve, spillways and retaining walls is admirable and fairly complete. So much cannot be said for dams. In the presentation of this very important subject poor judgment is shown. While it would not have been necessary to enter fully into the theory of constructing various types, as this is available in many other writings, there should have been presented a summary of standard designs with a discussion of conditions for which each is the best adapted. Such an analysis would be of much value, particularly if accompanied by cost da[illegible] of different parts of the country.

The treatment of structural types [illegible]anals, flumes, pipes and other conduits for [illegible]ucting the water supply from the diversi[illegible] the power-house cannot be commended. I[illegible] in fact less complete and advanced than tha[illegible] many other books on kindred branches of e[illegible]ering. The necessities of hydro-electric servic[illegible]ve developed distinct types of construction [illegible] such conduits. The demand for uninterru[illegible]l service and permanency is responsible for [illegible]s condition, which has recently found exp[illegible]ion in the work of hydro-electric engineers [illegible] the modern school.

Space does not permit the full dis[illegible]on of some apparent inaccuracies in the pr[illegible]tations, such as the statement that pipes shou[illegible]always be laid above ground and the design of pipe intake shown in Fig. 81. There are many situations requiring that riveted pipes be covered on account of temperature changes, which include leakage in seams and rivets, such leakage, no matter how slight, being disastrous by reason of oxidizing the metal. Nor does proper design follow Fig. 81, because a "bell mouth" or "taper inlet" is advisable to admit the full capacity of the pipe line and save loss of head.

The treatment of power stations is to be commended, if it be limited to low head stations, with reaction turbines. Nothing given is applicable to the other class of hydro-electric plants with impulse turbines.

Chapter 9 opens with an elementary discussion of the principles relating to hydraulic force and its dynamic energy obtainable for doing work through impulse or reaction upon freely rotating curved vanes. This is the first step towards the design of hydraulic turbines, and leads to the more complex studies in applied hydro-mechanics relating to turbine design.

Instead of following this logical trend, a discussion of which would be of great value to many American engineers, the book takes up that side of the subject which is generally presented with more or less completeness in the trade publications of hydraulic turbine manufacturers. While the material presented is with few exceptions well chosen and correctly stated, its value to hydro-electric engineers is slight, since their files and libraries are already overburdened with the same class of information.

On the other hand very little is available in the English language relating to the mechanics of design, the principles governing the relation of speed, power, efficiency and losses, the correct analysis required to minimize losses of

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Preface to Second Edition.—The very flattering reception given to the first edition of this work, resulting in an exceedingly large sale within the last three years, has pointed to the very general interest in the subject treated of, by the persons for whom the book was especially intended. In consequence of the very considerable developments in the industry, it has seemed desirable, after the exhaustion of the second impression of the first edition, to revise the manuscript completely, and to bring it up to date. This has been done with the results given in the accompanying pages.
The writer is indebted to Mr. C. N. Forrest for a revision of the matter regarding the methods of analysis which are described, and for many other suggestions.
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energy ... erosion etc. Recourse must now be had to ... opean authors, whose works are not translat... into English, in the pursuit of this class of ... wledge.

Nothi... f value is given in regard to impulse ... es. The illustration in Fig. 114 represe... a crude and practically obsolete type, and th... ompanying discussion gives no conception ... modern impulse turbine practice.

The ... ment on page 287, that tangential impuls... bines are always mounted on horizontal ... ts, is a mistake, whatever may be the rel... merits of mounting them horizontally or vert... ly. There are many instances of hydraulic ... pulse turbines mounted on vertical shafts ... h here and abroad.

The d... ussion on governors is also from the standp... of the catalogs of manufacturers, without ... entering into their theory. No information ... as to the conditions necessary to secure proper ... gulation of hydraulic plants with any type o... governor, is given. The question of sufficient ... power in the governor to move the gate or nozzle is not the only one, as the time required in so doing, the moment of inertia in the rotating masses of the equipment being governed, its speed, capacity, etc., are equally as, if not more, important in solving the problem.

The statement on page 329 that impulse turbines are now generally regulated by changing the area of the nozzle with a plug or needle operated by the governor is wholly erroneous. On the contrary such regulation for impulse turbines is secured by deflecting the nozzle or with a movable hood or collar in front of it, the motion being secured by attachment to a governor. The needle is used to regulate the discharge for different loads, and is usually moved by hand from the switchboard, or by an automatic device slower in its motion than the governor.

Where the regulation by needle valves for high heads has been attempted the results have been disastrous, as at the plant of the Animas Water & Power Co. in Colorado, which had its force main wrecked from this cause.

The discussion of governors omits to mention the Escher-Wyss type of hydraulic governor, which is now being made in this country by the Allis-Chalmers Co., and is used successfully in some of the most extensive and modern hydro-electric plants recently constructed, as for example the Los Angeles Edison Co.'s Kern River plant.

There is not much to be said on the discussion of electrical equipment, except that it is not up to date in some respects. This may possibly be pardoned by reason of the continuous and rapid advance in this branch, except as to some notable matters like the suspension type of insulator, to which no reference whatever is made. While the treatment of electrical matters is both elementary and incomplete, it gives some data of value in condensed form. In fact it is quite proper to give this subject only slight attention in a work of this kind, because most of the equipment required is standardized by the makers and the information necessary to choosing is readily secured from them.

With the limitations here stated the book has its value to the practitioner, but its principal use is to the beginner, who desires to take up low head hydro-electric work in the Middle West or East.

MUNICIPAL WATER SUPPLIES OF ILLINOIS.—By Edward Bartow. Water Survey Series No. 5, University of Illinois Bulletin. Urbana, Ill.: The University. Paper; 6 × 9 ins.; pp. 123; numerous tables.

Brief descriptions of public water supplies of Illinois are here given, accompanied in many instances by sanitary and mineral analyses of the water supplied.

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MANUAL OF REINFORCED CONCRETE AND CONCRETE-BLOCK CONSTRUCTION.—By Charles F. Marsh, M. Inst. C. E., M. Am. Soc. C. E., M. Inst. M. E., and William Dunn, F. R. I. B. A. New York: D. Van Nostrand Co. Flexible leather; 4 × 6½ ins.; pp. 290; 113 illustrations in the text, and 52 tables. $2.50, net.

The extensive work on "Reinforced Concrete," a large quarto volume published some years ago by Messrs. Marsh and Dunn, is one of the best known of the treatises on the subject, certainly the most complete of any published by a British author. Its main faults for American sale are its rather unwieldy size (partly due to the altogether too extensive discussion of various similar patented systems) and its use of British standards of measurement and practice. Realizing these deficiencies the authors have prepared the present hand-book in which

the object has been to give in a concise and handy form for every-day use the methods employed for the solution of every-day problems, with the information most frequently required in as condensed a form as possible consistent with a clear presentation of the subject.

To this end the matter published in the large edition has been abridged and condensed, many designing tables and diagrams have been added and the whole brought down to a hand-book style, in which the more involved discussions are omitted. The result is a very good designing hand-book, a trifle obscure, perhaps, in some of the theory, but still quite valuable to the office-man in concrete work. The adoption for American practice is quite obvious, for in cases where British units are used, the American analogue is also given, with a few exceptions, where the change has been omitted or forgotten. In some cases this omission is very confusing, especially when it is remembered that the British ton is 2,240 lbs. and that there the system of gaging concrete is pounds of cement to cubic feet of sand and stone, instead of the much simpler volumetric gage used in this country.

The question of construction, which should take up a large part of a hand-book, is only touched upon in some general statements and the reprinted instructions to inspectors issued by a well-known reinforced-concrete firm. In this portion there is room for great improvement, but the valuable tables and diagrams should be of great assistance in design, once the method of their derivation with the consequent field of application is understood by the designer.

THE TEN-YEAR BOOK OF CORNELL UNIVERSITY.—IV. 1868-1908. Ithaca, N. Y.: The University (David Fletcher Hoy, Chairman Committee). Cloth; 6 × 9½ ins.; pp. 793. $3.

This decennial publication of Cornell University contains, in separate alphabets, the officers of the university and all students of the university (in the long-term courses) since its foundation in 1868, together with their present occupation and address, and, if conferred, the degree to which they are entitled. It also contains a list of all short-term students, a geographical distribution index, and the list of graduation classes of the university from 1868-1908.

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Metals and Alloys.

Reviewed by BRADLEY STOUGHTON.*

PRACTICAL METALLURGY.—An Introductory Course for General Students. By Thomas Turner, Professor of Metallurgy in the University of Birmingham. London, England: Charles Griffin & Co., Ltd. Philadelphia, Pa.: J. B. Lippincott Co. Cloth; 5 × 8 ins.; pp. 163; five illustrations in the text. $1.25, net.

ALLOYS (Non-Ferrous).—By A. Humboldt Sexton, F. I. C., F. C. S., Professor of Metallurgy in the Glasgow and West of Scotland Technical College. Manchester, England: The Scientific Publishing Co. Cloth; 5½ × 8¾ ins.; pp. 283; 137 illustrations in the text. 7s. 6d., net; American price, $3.

The first book is a manual of laboratory experiments in metallurgy and assaying. In recent years it has become more and more the custom in engineering schools—long established in some—to supplement the class-room work in metallurgy, especially for students in metallurgy, mining and chemistry, with experiments performed in the laboratory by the students themselves. In some of the English universities this class of exercise goes under the name of "practical metallurgy." The published English literature on the subject is chiefly American and, although very good, is brief. Such additions as this one are welcome. Professor Turner aims to illustrate the basic principles of the subject he treats, and not only those who teach in the laboratory, but also those who have occasion to devise experiments for lecture demonstration, will find his ideas very useful. The explanations are concise and clear, and the necessary calculations plainly set forth. Less than two-thirds of the text is devoted to assaying and analytical chemistry, under the heads of sampling and weighing, examination of iron ores and iron and steel, assay of silver and gold, all of which is much more briefly treated than would be the case in a book intended primarily for students in a country which produces the precious metals. A little more than one-third is devoted to the study of metals and the metallurgical art itself, including some interesting information and experiments on metals and alloys, oxidation and reduction, fuel, fireclays, slags and fluxes, microstructure and electro-metallurgy, the two latter however, covering only two and three short pages respectively.

There has been no book in English, so far as we know, which covers both what we may call, for want of a better description, the theoretical and the practical side of the mixing and making of alloys. Such a one Professor Sexton has here given us, with the object of providing "for students, and more particularly for makers and users of alloys, a brief account of some of the advances which have recently been made in the study of alloys." It presents the new physico-chemical theory of solutions which has been so illuminating in the study of metals and alloys, as all will remember especially in connection with iron and steel, although these latter metals Professor Sexton does not touch upon here but has treated elsewhere.† It discusses the important and valuable properties of alloys, methods of research and investigation, precautions in mixing and melting and methods of preparation. We think it will prove a very useful handbook for both the classes for which Professor Sexton prepared it, and also as a reference book for all who are interested in alloys or in metallurgy. In the introduction Professor Sexton gives a partial definition of alloys and refers to the four principal methods of research, which are: chemical analysis, microscopic examination, the study of fusion and solidification, and of the physical properties. Then follows a very interesting discussion of the properties of alloys, such as strength, color, fusibility, electric properties, etc., and a chapter (perhaps too brief a one in view of its importance) on the phenomena of solidification. Chapter IV. then tells "what the microscope can teach," and includes a description of the apparatus, methods of preparation of samples and something of structures likely to be met. This is followed by another good chapter, on the properties of metals most often used, and then about 86 pages on the copper alloys, including especially brasses, bronzes, bearing metals, etc., where he has gathered together much information of great value. The white alloys—solders, pewter, Britannia metal, Babbitt and other white bearing-metals—are then discussed in more or less detail, and the alloys of nickel, of which the best-known is German silver. The last class of alloys treated, except a brief section on amalgams, are those of the precious metals, comprising chiefly those used for coinage and jewelry and the gold and silver solders. The book is completed by 40 pages on the preparation of alloys, including mixing and melting, the different types of furnaces and fuels, and a short note on electro-deposition. Precautions necessary in casting are mentioned in different places in the volume under the head of the several alloys. Altogether, the information here contained is so important and so well presented that no one interested in the study and the making of alloys can afford to be without it. The author says himself that the book does not contain a complete account of what has been done, and any one who expects to find in it a solution of all of his troubles will be disappointed, but he can find a great deal of value and usefulness, and will be stimulated by learning how much more he can discover by his own efforts.

*Adjunct Professor, Department of Metallurgy, Columbia University, New York City.

†The Metallurgy of Iron and Steel, by A. Humboldt Sexton.

Translation of a German Book on Electric Furnaces.

Reviewed by JOSEPH W. RICHARDS,* M. Am. Inst. M. E.

ELECTRIC FURNACES.—The Production of Heat from Electrical Energy and the Construction of Electric Furnaces. By Wilhelm Borchers, Privy Councillor, Doctor of Philosophy, Professor of Metallurgy and Director of the Institute of Mines and Electro-Metallurgy at the Royal Technical College, Aachen. Translated by Henry G. Solomon, Assoc. M. Inst. E. E., Consulting Electrical Engineer. London, New York and Bombay: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 224; 282 illustrations, mostly in the text. $2.50, net.

There are now several kinds of books on "Electric Furnaces." One is a record of laboratory experiments, and is a mine of accurate scientific information in that line; another is an uncritical compilation of good, bad, and indifferent proposals, mostly in the commercial way; a third is a fairly good combination of these two, but written by a professor with little laboratory or practical experience. The present is, for industrial purposes, an improvement on any of the preceding. It classifies and it describes, it explains and it criticises, and in most cases the author is quite competent to give the reader accurate and satisfactory information. The matter is well arranged, finely illustrated and altogether very readable.

There is one great fault in this work which the reviewer must mention if he would fulfill his duty. The writer of the book has an exaggerated opinion as to the value of some of the experiments which he himself made with electric furnaces between 1888 and 1898. According to the text, some of the most important improvements in electric furnace processes since then (and even some which were invented before!) were directly ascribable to the researches of the author. Most of such statements must be taken with many grains of salt; in fact, many of them are wholly unjustified by the real facts.

We hope this criticism will not deter anyone who wants a really good book on electric furnaces from purchasing the work, but it should be read with the above caution in mind.

In connection with induction furnaces, Mr. E. A. Colby is not given any credit, whereas he should have considerable. Although the book professes to be brought up to date, the interesting vacuum furnace of Arsen and the "Monox" furnace of Dr. Potter are left out. The omissions, however, are not numerous, and mostly of unimportant matter.

The translation is fairly well done, but some words are not given their exact equivalents in technical English and consequently the reader gets some exercise in guessing their meaning.

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PHILADELPHIA'S RAPID TRANSIT.—Being an Account of the Construction and Equipment of the Market Street Subway-Elevated and its place in the great system of service of the Philadelphia Rapid Transit Company, together with a Review of the Work of the Stone & Webster Construction Co. Philadelphia: The Millard Construction Co. 10 x 12 ins.; illustrated with numerous half-tone cuts and full-page portraits.

Of the work technically described by the above, an artistically-bound presentation copy has reached us. Without stopping to inquire whether the book will be available for general circulation among engineers we make record of it here because in at least one respect—aside from the unnecessarily costly ensemble—it is of quite unusual character. One of the six main divisions of the text is a remarkably graphic summary of the engineering difficulties encountered in the subway work. The six chapters are general descriptive statements of (1) the Philadelphia subway-elevated system of trackage as a whole, (2) the generating and converter stations, (3) the problems and methods involved in the construction of the subway section City Hall to Front Street, (4) the elevated structure, including the four-track bridge over the Schuylkill, (5) the track and the signal system, and (6) the operating equipment. Without disparaging the other parts of the text, of which we may mention the one describing the elevated structure as particularly well conceived, we can safely say that the review of the subway work, section 3, is the feature of the book. In very brief compass—only 29 pages—and without the aid of a single drawing (there being neither map nor drawing in the entire book), this section succeeds in giving a clear and interesting, almost captivating, survey of the complications that affected the central phase of the Subway-Elevated construction. It is evidently the work of one minutely familiar with the execution of the work in its broad aspects as well as its details, and endowed with skill in clear statement at the same time. It is a valuable technical essay on city subway building. Mainly on this account the book is a distinguished novelty among souvenir descriptive publications.

A New Edition of Turneaure and Russell's Public Water Supplies.

PUBLIC WATER-SUPPLIES.—Requirements, Resources, and the Construction of Works. By F. E. Turneaure, Dean of the College of Engineering, and H. L. Russell, Dean of the College of Agriculture, University of Wisconsin. With a Chapter on Pumping-Machinery by D. W. Mead, Professor of Hydraulic and Sanitary Engineering, University of Wisconsin. Second edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ x 9¼ ins.; pp. 808; 231 illustrations, mostly in the text, 102 tables, and 1 separate diagram. $5; English price, 21s., net.

The authors appear to have given this new edition of their valuable book on water-supply for municipal purposes a thorough overhauling. When the first edition of the book appeared, it was immediately recognized as being in advance of anything else then available on the subject suited to American needs. The lapse of seven years, during which no competing work has appeared, and the revision which has now been made, establish the book more firmly than ever in its position among American texts on water-supply.

The first edition was reviewed at some length in our issue of May 16, 1901. The present edition does not depart at all from the lines of the first one. Such changes as have been made are designed to bring the book up to date. The most marked changes appear in the sections relating to water purification, where the chapter on mechanical or rapid filtration has been rewritten and enlarged and more prominence has been given than before to the subject of coagulation. Other notable changes relate to methods of bacterial examination of water, the investigation of ground-water and the construction of collecting works, data on the use of water, data on rainfall and flow of streams, the construction of dams, and the application of reinforced concrete to conduits, dams, filters, reservoirs, and tanks.

One of the most valuable features of the original work was its references to the book and periodical literature on water-supply. These references, we are glad to see, have been brought well down into the present year.

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For the benefit of those who are not familiar with the earlier edition, we may outline the contents of the book very briefly, as follows: Part I. deals with Requirements and Resources, taking up in order the quantity of water required and sources of supply, and quality. Part II. deals with the Construction of Water-Works. It includes a chapter on Hydraulics, in which the various formulas and related matters are reviewed; this is followed by sections on collecting, purification and distributing works.

As in the earlier edition, only one chapter deals with operation and maintenance. It seems almost a pity that this chapter was not expanded into two or three or even more; but, after all, perhaps the authors were wise in not doing so, since the volume already extends to more than 800 pages, and water-works operation might profitably have a book to itself. Such a book, perhaps, would best serve its purpose if it was written by some of the best of our water-works superintendents or superintending engineers.

This book having, as already stated, attained its place as a standard, and there being no material change from the original plan, it seems unnecessary to attempt much in the way of criticism. It may be said, however, that in revising the chapter on Communicable Diseases and Water-Supplies the authors do not seem to have reflected the latter-day ideas as to the importance of other causes than water for the dissemination of typhoid fever. The only reference to the discussions that have arisen out of the agitation over continued typhoid at Washington since the filtration plant was put in operation there, is to one of the articles that have appeared in which this matter is mentioned. The only other point which we will question is the statement on page 217 regarding the life of riveted-steel pipe. After stating that it is probably safe to assume the life of cast-iron pipe 75 years, it is stated that "carefully protected riveted [steel] pipe will also have a very long life, but not so long as cast-iron." From this it might be inferred that the life of steel pipe was not materially less than that of cast-iron pipe.

PRACTICAL FARM DRAINAGE.—A Manual for Farmer and Student. By Charles Gleason Elliott, Chief Drainage Engineer and Chief of Drainage Investigations, U. S. Department of Agriculture. Second edition, rewritten. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. xv. + 188; 46 illustrations in the text. $1.50; English price, 6s. 6d., net.

Mr. Elliott states in his preface that he has entirely rewritten this book, which he first gave to the public some 25 years ago. The volume presents in handy and simple form the main principles and a goodly number of details of drainage, as applicable to the needs of farmers. The use of simple leveling instruments and simple means of mapping are described, the principles and practice of location and construction are set forth, figures are given on the cost of drainage work, and suggestions for record keeping are made. A brief chapter deals with the drainage of earth roads. There is also a chapter on special problems in drainage, in which muck lands, the prevention of erosion of hillsides, and salt marshes, are taken up. Finally, there is a chapter on the drainage of irrigated lands. The book as a whole seems well designed to fulfil its purpose, which is to supply "farmers and students" with the elements of the subject. Those wishing to go more fully into drainage problems are referred to "Engineering for Land Drainage," by the same author.

THE MODIFICATION OF ILLINOIS COAL BY LOW TEMPERATURE DISTILLATION.—By S. W. Parr and C. K. Francis. Bulletin No. 24, University of Illinois Engineering Experiment Station. Urbana, Ill.: The University. Paper; 6 × 9 ins.; pp. 48; 16 illustrations in the text.

This bulletin is essentially a preliminary report on several years of experimental work on the behavior of Illinois (bituminous) coals at comparatively low temperatures. The work recorded is uncompleted and aims at the eventual "anthracizing" of such coals. The work was of a laboratory-research character to develop the conditions which govern the decomposition processes. No attempt is shown, in this bulletin, directly to develop a commercial process of developing an artificial anthracite.

The low-temperature distillations were carried on in atmospheres of nitrogen, oxygen and steam. A survey of the data presented shows that the coal residue retains much of the volatile matter of the original coal, though this exists in a changed form. The coal residue has a marked resemblance in composition to the smokeless coals. The liquors resulting from the by-product recovery seemed to have no tarry compounds but were composed of oils, ammonia, phenol, etc.

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INSTRUCTIONS FOR EXPERIMENTS IN LABORATORY FOR TESTING MATERIALS.—By W. K. Hatt, Professor of Civil Engineering, Director Laboratory for Testing Materials, Purdue University. (Lafayette, Ind.: The Author.) Paper; 5½ × 8 ins.; pp. [illegible] illustrations in the text.

The [illegible] requirement of an intimate personal knowledge of the nature and peculiarities of constructive materials by engineering students is so important a thing that every real effort toward giving students such a knowledge merits appreciative recognition. The testing laboratory is one of the chief engines for imparting knowledge of materials, but in most schools it is not used to its utmost. The Purdue schedule of testing, outlined by Professor Hatt in this pamphlet, is distinguished by exceptional breadth and thoroughness, and engages the attention of educators from this fact. The pamphlet contains also some preliminary remarks on the purposes of the course and the methods to be followed by the student, and here is evidenced a clear perception of the important end of testing instruction, to give "a knowledge of materials by handling them and watching their behavior under stress."

A Mechanic's Handbook.

AMERICAN MACHINISTS' HANDBOOK.—And Dictionary of Shop Terms. A Reference Book of Machine Shop and Drawing Room Data, Methods and Definitions. By Fred. H. Colvin, M. Am. Soc. M. E., Associate Editor of "The American Machinist," Author of "Machine Shop Arithmetic," etc., and Frank A. Stanley, Associate Editor of "The American Machinist," Author of "Accurate Tool Work," etc. New York and London: Hill Publishing Co. Flexible leather; 4 × 7 ins.; pp. 511; numerous text illustrations and tables. $3, net.

There is much information that an intelligent mechanic or artisan requires that he cannot be expected to carry in his head or close by his hand in loose quantities. Such data and information of greatest use to him has not been found to the desired extent in standard mechanical-engineers' pocket books or even in works on machine shop practice, and it would seem that the authors of this handy volume had done a real service in assembling all this data with the recommended practices and methods in brief, clear statements.

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Publications Received.

ASSOCIATION OF ONTARIO LAND SURVEYORS.—Annual Report, and Proceedings at the 16th Annual Meeting since Incorporation, Held at Toronto, Feb. 25-27, 1908. (Killaly Gamble, Secy., Toronto, Ont.) Paper; 6 × 8¾ ins.; pp. 183; illustrated.

AUDELS GAS ENGINE MANUAL.—A Practical Treatise Relating to the Theory and Management of Gas, Gasoline and Oil Engines, Including Chapters on Producer Gas Plants, Marine Motors and Automobile Engines. New York: Theo. Audel & Co. Cloth; 5¼ × [illegible] ins.; pp. 469; 156 illustrations, mostly in the text. $2.

BULLETINS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 5½ × 9 ins.

No. 351: The Clays of Arkansas. By John C. Branner. Pp. 247; 1 plate in pocket and 20 text illustrations.

THE DESIGN AND EQUIPMENT OF SMALL CHEMICAL LABORATORIES.—By Richard K. Meade, Editor of "The Chemical Engineer," Author of "Portland Cement," etc. Chicago, Ill.: The Chemical Engineer Publishing Co. Cloth; 6 × 9¼ ins.; pp. 136; 111 illustrations in the text. $2, net.

ELEMENTARY MANUAL OF RADIOTELEGRAPHY AND RADIOTELEPHONY.—For Students and Operators. By J. A. Fleming, M. Inst. E. E., Pender Professor of Electrical Engineering in the University of London, Professor of Electrical Engineering in University College, London, etc. London, New York and Bombay: Longmans, Green & Co. Cloth; 5¾ × 9 ins.; pp. 340; numerous text illustrations. $2, net.

ERECTING WORK.—Compiled and Written by Hubert E. Collins. New York and London: Hill Publishing Co. Cloth; 4½ × 7 ins.; pp. 140; 110 illustrations in the text. $1.

EX-MERIDIAN ALTITUDE, AZIMUTH AND STAR-FINDING TABLES.—With Diagrams for Finding the Latitude and Facilitating Plotting Lines of Position and Giving New and Practical Methods for Identifying Stars in Cloudy Weather. Latitudes 0°-65°; Declinations 0°-71° North and South. By Lieutenant-Commander Armistead Rust, U. S. Navy. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 6 × 9½ ins.; pp. ll. + 393; six folding plates. $5.

FOWLER'S MECHANICS' AND MACHINISTS' POCKET BOOK AND DIARY, 1909.—A Synopsis of Practical Rules for Fitters, Turners, Millwrights, Erectors, Pattern Makers, Foundrymen, Draftsmen, Apprentices, Students, etc., etc. Edited by William H. Fowler, M. Inst. C. E., M. Inst. M. E., etc. Manchester, England: Scientific Publishing Co. Boards; 3¾ × 6 ins.; pp. 448; numerous illustrations in the text. 6d., net; American price, 20 cts.

GRAPHICAL DETERMINATION OF EARTH SLOPES, RETAINING WALLS AND DAMS.—By Charles Prelini, Professor of Civil Engineering, Manhattan College, New York City, Author of "Earth and Rock Excavation," etc. New York: D. Van Nostrand Co. Cloth; 6 × 9¼ ins.; pp. 129; 75 illustrations in the text. $2, net.

HANDBUCH UEBER TRIEBWAGEN FUER EISENBAHNEN.—Prepared by C. Guillery, at the order of Der Verein Deutscher Maschinen-Ingenieure. Munich and Berlin: R. Oldenbourg. Cloth; 6½ × 9½ ins.; pp. 202; 93 illustrations in the text. 7½ marks; American price. $3.

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A MANUAL OF UNDERGROUND SURVEYING.—By Loyal Wingate Trumbull, Consulting Mining Engineer. New York and London: Hill Publishing Co. Cloth; 6 × 9¼ ins.; pp. 251; 94 illustrations, mostly in the text. $3, net.

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MODERN PRACTICE IN MINING.—Vol. I.: Coal, Its Occurrence, Value, and Methods of Boring. By R. A. S. Redmayne, M. Inst. C. E., M. Inst. M. E., His Majesty's Chief Inspector of Mines, etc. London, New York and Bombay: Longmans, Green & Co. Cloth; 5½ × 8¾ ins.; pp. 199; 123 illustrations in the text, and one large folding table. $2, net.

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PROBLEMS OF CITY GOVERNMENT.—By L. S. Rowe, Ph.D., LL.D., Professor of Political Science, University of Pennsylvania. New York: D. Appleton & Co. Cloth; 5 × 8 ins.; pp. 358. $1.50, net.

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A TEXT-BOOK ON ROADS AND PAVEMENTS.—By Frederick P. Spalding, M. Am. Soc. C. E., Professor of Civil Engineering, University of Missouri. Third edition, revised and enlarged. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ × 7½ ins.; pp. 340; 51 illustrations in the text. $2.

THEORY AND DESIGN OF REINFORCED CONCRETE ARCHES.—A Treatise for Engineers and Technical Students. By Arvid Reuterdahl, Chief of Bridge Department, Engineering Department, City of Spokane, Wash. Chicago and New York: The Myron C. Clark Publishing Co. Cloth; 6 × 9¼ ins.; pp. 126; 41 illustrations, mostly in the text, and 17 tables. $2, net.

WATER POWER OF HALIFAX, NOVA SCOTIA.—Part I., Dartmouth Lakes Power. By F. W. W. Doane, City Engineer, Halifax. (From Proceedings and Transactions of the Nova Scotia Institute of Science, Vol. XII., Part 1.) Paper; 5½ × 8¾ ins.; pp. 21 to 33.

WATER-SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.

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CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(denotes that this work is advertised in Engineering News.)*

The following plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

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RAILWAYS.

ARTESIAN BELT R. R.—Application for a charter has been made in Texas for this company. The line has been surveyed and located, and contract for grading, track and surfacing has been let to the J. F. BURNS CONSTRUCTION CO., of Devine, Texas. Ties are on hand to complete line from Macdona south to New Artesia, about 40 miles, Macdona being on the Southern Pacific Ry. not far west of San Antonio. From New Artesia the line is to be continued to Simmons City, in Live Oak County, Tex., between 20 and 30 miles. Contract is to be completed by June 1, 1909. At the present survey will be made for the latter portion of the line, and then it will be arranged to extend further toward the Rio Grande. William Bradburn is Ch. Engr., 215 Alamo Plaza, San Antonio, Tex. Capital stock, $70,000. The incorporators are Charles F. Simmons and A. M. Bates, Excelsior Springs, Mo.; E. P. Simmons, Robert Clarke, C. N. Feamster, J. O. Terrell, Dick O. Terrell, J. P. Barclay, A. M. Avant and Charles Paterson, San Antonio, Tex., and Jourdan Campbell, Campbelltown, Tex. Noted, last week under "Texas."

ATCHISON, TOPEKA & SANTA FE.—Under the terms of the act of the Legislature by which this company merged several of its lines in east Texas, it is required to build an extension of its line from Longview, Tex., to some point on the Red River, a distance of about 125 miles, within two years from the date the consolidation act went into effect. It was also required to build an extension from Center to Timpson, a distance of about 15 miles, within the same period. It is stated that the work of building these extensions will be started in a few months.

BUENA VISTA & NORTHWESTERN.—Incorporated in Georgia, with $200,000 capital, to build a railroad from Buena Vista, Ga., on the Central of Georgia Ry. northwest to Mauk, on the Atlanta, Birmingham & Atlantic Ry., about 17 miles. The incorporators include: J. A. McLeady, C. V. Sprinkle, S. G. Collier, W. S. Lounsburg, H. V. Wilson, John Y. Smith, S. L. Lloyd, E. W. Lively, J. G. Wynn and E. R. De Borde, all of Atlanta.

CALIFORNIA.—The Fresno Copper Co., Fresno, Cal., has awarded contract to the SHATTUCK-EDENGER CO., Los Angeles, Cal., for the construction on the company's private right-of-way of a standard-gage railroad from the Pallasky branch of the S. P. R. R., a short distance east of Gordon station, to a connection with the north end of the existing tracks of the company at its mine, 3.78 miles. The construction work will be commenced at once.

CANADA.—Three new railroad branches were opened on Nov. 4 for traffic in the Canadian Northwest. The Canadian Northern Ry. Co. inaugurated its service on the Brandon-Regina Line, 225 miles long. It parallels the Canadian Pacific almost the entire distance, running a few miles south. The Canadian Pacific line from Yorkton, Saskatchewan, to Leslie, Saskatchewan, 66 miles, was opened, as was also its line running north from Moose Jaw, Saskatchewan, to Conan, known as Outlook, Saskatchewan. It comprises a section 91 miles long which will eventually reach Stettler, Alberta.

CORBIN COAL & COKE CO.—This company, with headquarters at Spokane, Wash., has been registered in British Columbia as an extra-provincial company for the purpose of building railroads in that province. J. A. Harvey, Cranbrook, B. C., is the local representative of the company.

DALLAS, CLEBURNE & SOUTHWESTERN.—Steps have been taken by the Dallas, Cleburne & Southwestern R. R. Co. to extend its line from Egan to Dallas, a distance of about 25 miles, and south from Cleburne to Glen Rose, a distance of about 30 miles. It is stated by B. F. McDonald, Pres. of this road, that it is planned to ultimately extend the line south to San Antonio, a distance of more than 200 miles. The road is now operated by the Missouri, Kansas & Texas.

GRAND TRUNK PACIFIC.—Following the announcement of the awarding of the contract to THOMAS KELLY & SONS, Winnipeg, for the construction of shops for the Grand Trunk Pacific at Winnipeg, Man., involving the expenditure of over $500,000, the Grand Trunk Pacific Co. announces the letting of contracts for three new stations on the main line west, at Watrous, Biggar and Wainwright, to the CARTER-HALLS-ALDINGER CO., of Winnipeg. In addition, the Grand Trunk Pacific Co. has awarded to JAMES STEWART & CO. the contract for a 4,000,000-bushel elevator at Fort William, which will be absolutely fireproof and have all of the equipment necessary for cleaning, drying and properly handling grain. McDonald and Stewart, directors of the Scottish Cooperative Wholesale Society, Winnipeg, announce that contracts have been let for six new elevators on the Grand Trunk Pacific in Manitoba, and that farther west they will, in the near future, erect others.

HARRISON & MINERAL BELT.—The SOUTHWESTERN CONSTRUCTION CO. will build the proposed line from Harrison to Bergman, Ark., 7½ miles. After completing this section it is intended to go to Clarksville, Ark., or some point on the Little Rock & Fort Smith R. R., about 100 miles. L. D. Pride is Engr.-in-Charge at Harrison, Ark. The railroad company has not yet been organized, but it is intended to have the local company do the work.

ILLINOIS CENTRAL.—This company has made plans for extensive river terminal railroad inclines and wharves on the river front in New South Memphis adjoining the big yards at Nonconnah, just south of Memphis, Tenn. This work was projected more than a year ago, but was held up because of the financial stringency. Contract is ready to be let. The company has already secured the site for these improvements. It is estimated that the terminals will cost from $250,000 to $500,000. A. S. Baldwin, Ch. Engr., Chicago.

LYNNHAVEN TERMINAL.—Application for a charter has been made by this company in Virginia. The company projects a railroad from Norfolk to Cape Henry, to operate a ferry line to Cape Charles and build a road from that point to some point on the Rappahannock River. It also contemplates the operation of a line of steamers up the Rappahannock River. Alvah H. Martin, of Norfolk, is named as one of the promoters.

OCHILTREE, ENID & SOUTHWESTERN.—This company will be chartered with $500,000 capital stock, to build a railroad from Dalhart to Ochiltree, Tex., a distance of 101 miles. This will be the first link in the line and when it has been completed the road will be projected to Enid, a distance of 20 or 30 miles from the temporary terminal. George M. Perry, County Judge, of Ochiltree, is one of the chief promoters and probably will be its president. The road will run through Dallam, Moore, Hutchinson, Hansford and Ochiltree Counties.

OCILLA SOUTHERN.—J. A. J. Henderson, W. N. Smith, Wm. Henderson, R. V. Paulk, Jno. D. Paulk, R. L. Henderson, J. L. Paulk, M. J. Paulk, Reason Henderson and H. J. Quincey, all of Ocilla, Ga., have incorporated this company with $150,000 capital, to build a railroad from Ocilla, Ga., south for a distance of about 30 miles.

QUINCY & EASTERN.—J. J. Rutledge, of Quincy, Cal., one of the promoters of the Quincy & Eastern Ry., which is to connect this city with the Western Pacific Ry. at Hartwell, and which will also tap a fine timber belt at the junction of Slate and Spanish creeks, has made announcement that actual construction work on the railroad will be commenced soon, according to the San Francisco "Chronicle."

SAN DIEGO, EL PASO & ST. LOUIS.—Application has been made for charters for the San Diego, El Paso & St. Louis R. R. It will run from El Paso to the boundary lines of Texas and New Mexico, 100 miles. The incorporators are A. Courchesne, James A. Dick, John A. Happer, W. C. Davis, Horace B. Stevens, Z. T. White, L. E. Booker, J. J. Mundy, W. J. Harris, W. Cooley, Irvin John, J. A. Smith, all residents of El Paso, Tex. Capital stock, $100,000.

VIRGINIA RY.—At a meeting of the stockholders of the Virginian Ry. Co. at Norfolk, Va., on Nov. 6, the common stock was increased from $32,500,000 to $36,000,000. The only announcement made concerning this action was that it was for "corporate purposes."

It is reported that a line is to be built from Roanoke to Floyd, Va., 25 miles. H. Fernstrom is Ch. Engr., Norfolk.

ELECTRIC RAILWAYS.

RUTLAND, VT.—A bill has been introduced in the House of Representatives at Montpelier by Representative Stafford, of Wallingford to incorporate the Otter Creek Electric Ry. Co. A charter is asked to build and operate an electric railway line from Rutland through Clarendon, Wallingford, Danby, Mount Tabor, Dorset, Manchester, Sunderland, Arlington, Shaftsbury and Bennington. H. B. Barden, of the Barden Mfg. Co., of Wallingford, is interested.

NEW YORK, N. Y.—We are officially advised that the Pennsylvania R. R. Co. has awarded contract for the completion of the electrification of the Pennsylvania Terminal in this city to the WESTINGHOUSE ELECTRIC & MFG. CO., 165 Broadway, New York, and Westinghouse Bldg., Pittsburg, Pa. The contract provides for the electrification of the entire Pennsylvania system from Harrison, N. J., to Jamaica, L. I. The initial amount of the apparatus required

under this part of the contract will be $5,000,000, but this is not the full amount that the work will cost, as it has not been determined how much more than the contract calls for will be done. Work on 100 electric locomotives will be begun at once and on a number of motor cars. To run the system 250,000 HP. will be required. The contract will cover a period of about two years. George Gibbs, 8 Bridge St., New York, is Ch. Engr. of Electric Traction for the Pennsylvania Terminal & R. R. Co.

ONEIDA, N. Y.—D. C. Haddock, of Oneida, is interested in plan to construct an electric railway from the city of Rome to the State Custodial Asylum, a distance of two miles. A company is to be organized as soon as $25,000 capital stock is raised. It is planned eventually to extend the projected line to Oneida Castle and there connect with the West Shore Railroad, a distance of 13 miles.

DONORA, PA.—The Donora & Eldora Street Ry. Co. has awarded the contract for the construction of its road, which will connect this place with Eldora, a distance of about four miles, to FRANK DONATELLA, of Pittsburg, Pa. Work will be started at once and completed this winter.

CHESTER, PA.—Joseph Shortledge, Concordville, Pa., is interested in plan to build an electric railway from Chester to Llewellyn, Concordville and West Chester.

ERIE, PA.—The Conneaut & Erie Traction Co., it is announced, will make extensive improvements to its line. Robt. W. Watson, Receiver, Harrisburg, has requested permission to issue $20,000 worth of bonds to make necessary repairs and improvements to the roadbed and tracks of the Conneaut & Erie Traction Co. of Pennsylvania and the Conneaut & Erie Traction Co. of Ohio. R. W. Palmer is Supt., Erie.

RICHMOND, VA.—The Richmond, Urbanna & Peninsular Railway Co. has been granted a charter by the Corporation Commission to build a line or lines connecting West Point, Urbanna and other places in several counties. The total length of line, including branches, will be 116 miles. Capital, $100,000 to $500,000. The officers are: Pres., John C. Robertson; Vice-Pres., Boyce D. Brooker, both of Richmond; Treas., George C. Bland, of Shacklefords, Va.; Secy., James Taylor Robertson, of Richmond; Directors: John C. Robertson, George C. Bland, Walter H. Ryland and J. W. Hurley, of Urbanna; J. Taylor Robertson, of Chesterfield; Alfred C. Palmer and Boyce D. Brooker, of Richmond, and George W. Brown, of Saluda, Va. The main line, from West Point to Urbanna, 16 miles, will first be built, after which about 60 miles of branches will be constructed. Survey has been made, but contract will not be let until all right-of-way is secured. Col. C. P. E. Burgwyn, of Richmond,, is Engr.-in-Charge.

NORTHFORK, W. VA.—The Northfork Realty Co. is interested in proposed electric line. Col. L. E. Tierney, of Powhatan, W. Va., is Pres.; Judge John J. Lincoln, Elkhorn, W. Va., Vice-Pres.; Dr. L. H. Clark, Kyle, W. Va., Secy. and Treas.; Aaron Catzen is Gen. Mgr. The other incorporators are John J. Tierney, Elkhorn, W. Va., and Louis R. Page, Upland, Pa.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Co., Gulfport, is arranging to extend its line from Gulfport to Pass Christian. J. A. Jones, Gulfport, is Gen. Mgr.

GARY, IND.—Application has been made by the Valparaiso, Hobart & Gary Elec. Ry. Co. for a franchise in this town.

AURORA, ILL.—The property of the Aurora, DeKalb & Rockford Elec. Traction Co. will be sold by John S. Sears, Master in Chancery, at County Court-House in Geneva, Ill., on Nov. 30 at 11 a. m. The sale includes all right-of-way, track, roadbed and appurtenances thereunto belonging, and its line of railroad, as now laid out, occupied and used by the Aurora, DeKalb & Rockford Electric Traction Co., commencing at the intersection of the center line of Plum St. with the Geneva branch of the Chicago, Burlington & Quincy R. R. Co., in the City of Aurora, Kane County, Ill., and thence northwesterly through the towns of Kaneville, Maple Park, Cortland and through and into the City of DeKalb, to the intersection of the center line of Main St. with the main line of the Chicago & Northwestern R. R. Co. Also, all right, title and interest of company in and to about 170 acres of gravel land which adjoins its right-of-way. This railroad is located in the Counties of Kane and DeKalb, and is about 27 miles in length.

SPRINGFIELD, ILL.—The Springfield & Jacksonville Electric Ry. Co. has been incorporated in Illinois to construct an electric railway through the counties of Sangamon and Morgan, from the city of Springfield to Jacksonville. Headquarters, Springfield. Capital stock, $100,000. Incorporators: D. H. Sims, D. B. Sims and O. J. Lucas, of Latham, Ill.; S. T. Stanley and C. R. Cronk, Chicago.

KANSAS CITY, KAN.—The Kansas City & Olathe Electric Ry. Co., Kansas City, Mo., has been granted a franchise by the Wyandotte County Commissioners to extend its line north from the present terminus in Rosedale to Kansas City, Kan. The company is hereby given the right-of-way for an electric railway along the south side of the range of hills dividing Turkey Creek Valley from the Kaw Valley, adjacent to the St. Louis & San Francisco R. R. right-of-way. It provides also for the right to construct a tunnel through the hills to a point near the Fifth St. bridge. F. P. Dickson, Gumbel Bldg., Kansas City, Mo., is Pres. and Pur. Agent.

BOLIVIA, MO.—The Niangua & Western Ry. Co. has been incorporated in Missouri to construct an electric railway from Lebanon through Long Lane, Buffalo and Halfway to Bolivar. The length of the road will be 60 miles. It is stated that the company owns the entire right-of-way, and that the roadbed is now ready for the laying of rails, except a small part where some grading will have to be done. The route of the proposed line is that of the old Laclede & Fort Scott R. R., which was organized years ago for the purpose of constructing a steam railroad from Lebanon to Fort Scott, Kan. Capital stock, $600,000. Incorporators: George Lovan, James Lovan, S. L. O. Lovan, A. B. Lovan and J. N. Smith, all of Springfield, Mo.

COLUMBIA, MO.—O. W. Sprate, St. Louis, Mo., and V. M. Dissaffrey, Buffalo, N. Y., are backing a project to connect Columbia and Mexico with an electric railway. The length of the road would be about 30 miles.

FAYETTEVILLE, ARK.—Louis Moulton, of Boston, has applied for a street-car franchise to connect with an electric railway projected from Siloam Springs to Huntsville, Ark. G. T. Propper, of Minneapolis, is interested in plan to build a belt line connecting with a road to Joplin, Mo., using an old right-of-way granted for a steam road from Fayetteville east six miles.

EPHRATA, WASH.—The Board of County Commissioners has granted a franchise to O. A. Kuck to construct an electric railway connecting Adrian, Ephrata and the Soap Lake health resort.

LYNDEN, WASH.—The Nooksack Valley Traction Co., Bellingham, Wash., has been granted a franchise to operate an electric street railway through Lynden. Fully noted on Oct. 29.

SPOKANE, WASH.—Jay P. Graves, Pres. of the Spokane & Inland Empire R. R. Co., announces that the company has no intention of giving up its franchise to build a tunnel in the business district of Spokane, Wash. Construction may begin next February. The company has three years in which to have one track in operation. The tunnel will be in Front Ave., and will cost $1,000,000.

SPOKANE, WASH.—Albert M. Dewey, Pres. of the Okanogan Elec. Ry. Co., Spokane, states that the sale of bonds is practically accomplished, and that work will begin soon. The line and equipment will cost $2,621,280. The company has a 50-year franchise, right-of-way and charter for a steam or electric railway of 80 miles from Nighthawk, where it will connect with the Victoria, Vancouver & Eastern extension of the Great Northern Railway to the head of navigation on the Columbia River, where connection will be made with river boats and the main line of the Great Northern Ry., giving it outlets to Spokane on the east and Puget Sound points on the west. The main line will pass through Loomis, Okanogan, Ophir, Malott, Brewster and the Q. S. mines, near which a smelter will be built, and there will be branches to Conconully, Omak, Riverside and other desirable points. Horace B. Skinner has been appointed Supt. of Construction. The other officers of the company are: George D. Needy of Spokane, Secy., and M. L. Bevis, Treas. The Knickerbocker Trust Co. of New York is trustee for the organization. Company was incorporated under the laws of Washington with $3,000,000 capital stock and authorized bond issue of $4,000,000. The company owns water rights, which will develop not less than 30,000 HP. Part of this will be utilized by the railway, the rest being sold for light and power to mines and manufactories and lighting towns on its line. The present population of Okanogan County is about 15,000, showing an increase of 176% from 1900 to 1905. Five new towns will be built on the line and four of these should have 5,000 or more population within five years, while the other is bound to be near the 50,000 mark. Previously noted.

STOCKTON, CAL.—Morris L. Brackett, Vice-Pres. of the San Joaquin Valley Elec. Ry. Co., Stockton, announces that the company's engineering corps is now in the field making the final surveys for the route for this projected railway system. The entire right-of-way has been secured. As soon as the surveys have been made construction work will be started. The road as projected will be standard-gage line and will extend from Stockton through French Camp, Mantica, Moreno, Summer Home, Ripon, Salida and Wood's Colony to Modesto, about 35 miles. The company proposes to operate gasoline motor cars. The repair shops will be built at Stockton. Koch's Grove, an amusement park, will be reached by the road. Headquarters, 518 East Main St., Stockton. Capital stock, $1,000,000, of which $35,000 has been subscribed. Bonds have been authorized to the amount of $500,000. Officers: H. C. Holmes, New York, Pres.; Morris L. Brackett, Vice-Pres.; Charles E. Dickey, San Francisco, Cal., Secy.; H. E. Teter, Stockton, Treas. Noted on Oct. 29.

STOCKTON, CAL.—The Stockton Terminal & Eastern R. R. Co. has been incorporated in California to build a railway from Stockton to Jenny Lind. Capital stock, $600,000, of which $30,000 has been subscribed. Directors: A. Shane, Indianapolis; W. H. Newell, Stockton; A. A. Grant, Sonora; N. W. Condon, Berkeley; E. F. Davis, S. L. Steidley, Oakland; J. E. Adams and Robert F. Burns, Berkeley.

SANDPOINT, IDAHO.—The Mayor has appointed a committee to confer with the promoters and backers of the proposed electric railway which will connect Sandpoint and Kootenai, for which franchise is asked by F. J. McBride, J. B. Southmayd, V. M. Smith and F. M. Molyneaux.

LIGHT AND POWER PLANTS.

(denotes that this work is advertised in Engineering News.)*

*BOSTON, MASS.—Guy C. Emerson, Supt. of Streets of the City of Boston, 47 City Hall, invites parties having street lighting apparatus adapted to systems other than the present system of low-pressure gas mantles to demonstrate, if they so desire, during the continuance of the present contract for street lighting, with a view to the improvement of the present system upon the expiration of the present contract on Sept. 15, 1909.

MANCHESTER, CONN.—Plans are being made by the Glastonbury Light & Power Co. to rebuild and improve its system in Manchester. The company has awarded a contract to the J. G. WHITE CO., 49 Exchange Pl., New York, N. Y., for the construction of a sub-station. W. L. Ripley is Local Mgr.

HARTFORD, CONN.—The Board of Contract and Supply has rejected all bids submitted for lighting the streets of the city for five years. New bids will be received until Jan. 4. The time intervening before the opening of the bids is for the purpose of allowing prospective bidders opportunity to properly investigate the matter.

BUFFALO, N. Y.—The Board of Supervisors has awarded a contract to the DUBOIS IRON WORKS, of DuBois, Pa., at $6,762 to install a gas engine in the 74th Regiment Armory in connection with the electric light plant.

NEW YORK, N. Y.—The interior conduit and wiring system for vacuum tube lighting on first floor of the New York courthouse has been awarded to McLEOD, WARD & CO., 27 Thames St., New York, at $3,795. Time to complete, Feb. 25, 1909.

GENEVA, N. Y.—The Geneva-Seneca Electric Co. has commenced work on the construction of its power-house here, it is stated. The company proposes to expend about $150,000, of which $75,000 will be used for the power-house and equipment and the remainder upon its transmission system. Contracts have been placed with the GENERAL ELECTRIC CO., Schenectady, N. Y., for the electrical machinery, including a Curtis steam turbo-generator set. Babcock-Wilcox water tube boilers will be installed; the condensers will be furnished by the HENRY R. WORTHINGTON CO., 115 Broadway, New York, N. Y. The plant will have an output of 1,000 HP. and will furnish electrical energy in Waterloo and Seneca Falls, as well as Geneva. The old station will be kept intact for the present to use for supplementary and emergency purposes. F. C. Bloodgood, New York, is Mgr.

GENEVA, N. Y.—We are officially advised that the Geneva-Seneca Electric Co. has let general contract to the DELANEY ROBERTS CONSTRUCTION CO., 103 Park Ave., New York, for a fireproof 1-story brick power-house, 75 × 50 ft. The GENERAL ELECTRIC CO., Schenectady, N. Y., has the contract for the equipment. Total cost, $25,000.

SMITHTON, PA.—The Councils have passed a resolution authorizing the borough authorities to enter into a contract for the establishment of an electric lighting plant here, and the contract has been awarded to DeCORT BROS., of Pittsburg, Pa. The plant will cost about $20,000.

WARREN, PA.—Bids will be received until 3 p. m., Nov. 17, by S. W. Waters, Secy. of the Bd. of Trustees of the State Hospital for the Insane, Warren, Pa., for furnishing and installing two 80-brake HP. natural gas engines and for two triplex power pumps of an approximately 955-gallon capacity per minute. Plans and specifications may be obtained from Charles R. Simpson, Warren, Pa., Engr.

JOHNSTOWN, PA.—Bids are asked by George E. Hamilton, City Clk., until 5 p. m., Nov. 25, for lighting the streets, alleys, public buildings, thoroughfares, etc., of this city for periods of both five and ten years from Jan. 1, 1909, with electricity. The contract will cover about 500 arc lamps, furnishing and operating all incandescent lights of 70-c.p. and meters for registering the amount of current used. The city will reserve the right to increase the number of either or both kinds of lamps at the same rate.

*PHILADELPHIA, PA.—Bids are asked until noon, Nov. 17, by George R. Stearns, Dir. Dept. of Public Works, Philadelphia, for lighting the incandescent naphtha lamps and furnishing lamp posts in the city of Philadelphia.

DANVILLE, VA.—City has awarded contract to the ALLIS-CHALMERS CO., Milwaukee, Wis., for equipment to be installed in the municipal electric-light plant, including boiler, 500-KW. turbo-generator set, etc. $22,000 is appropriated for improvements. F. Talbott is Supt. Water, Gas and Electric Light Dept.

NEW CUMBERLAND, W. VA.—An electric light company under a West Virginia charter, to be known as the Panhandle Electric Co., will erect a power plant at New Cumberland for lighting the town and supplying power. The company has an authorized capital of $50,000 and included in the incorporators are Joseph Bryan, S. N. Dunbar and J. L. Merrill of Pittsburg, R. S. Rudolph of Suter Station, Pa., and A. S. Cooper of New Cumberland. Plans have been prepared for an initial plant to be operated by gas engines.

VADE MECUM, N. C.—Bids will be received about Dec. 1 for constructing an electric power plant here. Estimated cost, $65,000. H. P. Knight is Lessee of the Vade Mecum Springs.

MANCHESTER, N. C.—The Little River Power & Transmission Co., which was recently incorporated, has awarded a contract to the THOMAS B. WHITTED CO., of Charlotte, N. C., for the construction and equipment of its power plant. The Little River Power & Transmission Co. has a franchise to furnish electricity for lamps in Manchester and will operate a street railway system in Fayetteville, N. C.

EAST POINT, GA.—See item under Water Supply—Irrigation.

ALBERTVILLE, ALA.—The Sand Mountain Electric Co. has been organized with E. O. McCord Pres. and Gen. Mgr., W. E. Snead Vice-Pres., J. W. Baker, Secy. and J. W. Walker, Treas. The company will install a steam plant in [illegible] Highlands to furnish Albertville with [illegible] lights, a 25-year franchise and [illegible] having been secured. 15 arc and 600 [illegible] desent lights can be furnished. This [illegible] will be operated until arrangements [illegible] development of water-pow[illegible] be made for Falls, four miles from [illegible] Short Creek WESCO SUPPLY CO., Se[illegible]ville. The Ave., St. Louis, Mo., ha[illegible] St. and Clark furnish two 80-HP. boil[illegible] contract to engine and one 90-KW [illegible] one 125-HP NEY & TIDMORE, of A[illegible]tor. DOW nish poles. M. A. Gro[illegible]e, will fur Ala., is Electrician-in-Ch[illegible] Birmingham.

WAVERLY, LA.—The [illegible] for the construction of the pow[illegible] for the electric light and power [illegible] and water works system has been [illegible] to G. W CLARK of Waverly, at $[illegible]

ELWOOD, IND.—E. R. [illegible] who purchased the Elwood heat [illegible] light plants, contemplates making [illegible] improvements, and will install new [illegible] machinery.

NEW CASTLE, IND.—A[illegible] A. L. Olds, of Detroit, Mich[illegible] Doty and site in this city and will [illegible] secured a ducing plant. [illegible] a gas pro-

EVANSVILLE, IND.—The [illegible] tors of the Evansville & Southern [illegible] Traction Co. have voted to build a [illegible],000 power plant in this city. Bids will be received soon.

CEDAR RAPIDS, IOWA.—[illegible] Cedar Rapids Light & Power Co. will [illegible] the construction of a concrete dam [illegible] the Cedar River, 16 miles below the [illegible] The dam will be 20 ft. high and will develop 4,800 HP. The point where the dam is to be constructed is known as the [illegible]. It is anticipated the plant can [illegible] used more than two-thirds of the year [illegible] account of extreme low water or flood [illegible] hence the steam plant now in use will be retained.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Co. has completed arrangements for the expenditure of $[illegible],000 on the Nevers dam on the St. Croix River. The Nevers dam is located twelve miles above St. Croix and after the contemplated improvements and repairs will be used in conjunction with the dam at St. Croix Falls, where the 25,000-HP. power plant of the General Electric Co. is located. The repairing of the old Nevers dam, which was built 16 years ago, is made essential in order to furnish sufficient power to the big plant. The work has been let to a contractor and will be superintended by the company. Stone & Webster, 147 Milk St., Boston, Mass., are Gen. Mgrs.; A. W. Leonard, Minneapolis, is Mgr.

BUFFALO, MINN.—We are officially advised that contract was let to the NORTHWESTERN ELECTRIC EQUIPMENT CO., 181 East Fourth St., St. Paul, Minn., on Oct. 29, for a 50-KW. alternator, 19 arc lamps, transformers, etc., also pole line and wiring, construction material. O. Claussen, is Engr., St. Paul. H. C. West, Recdr.

WOOD RIVER, NEB.—F. K. WHEELER has been awarded a contract for the construction of an electric light plant and water-works system for $19,550.

PAPILLION, NEB.—Plans are being prepared by R. H. Oliver, Engr., of Omaha, Neb., for the construction of a power-house for the Nebraska Light & Power Co.

GARDEN CITY, MO.—We are officially advised that plans are being prepared for the proposed power plant to be constructed by the Kansas-Colorado Electrical Transmission Co., in Garden City. The plans call for a building 130 × 160 ft., in which will be placed three units of 3,750 KW. each. The plant will be operated by steam turbines. Sargent & Lundy, Railway Exchange Bldg., Chicago, Ill., are Engrs. L. M. Markham is Division Engr., Garden City.

ELSBERRY, MO.—Bids are asked by the City Clerk until Nov. 12 for furnishing material and construction of a municipal electric light plant, including horizontal tubular boilers, high-speed direct-connected engine, heaters, boiler feed pumps, steam piping, alternating-current generator, direct connected, switchboard, incandescent street lighting apparatus, pole line, transformers, etc., and the construction of a brick power-house. W. A. Fuller, Chemical Bldg., St. Louis, Mo., is Engr.

ST. LOUIS, MO.—According to the St. Louis "Globe-Democrat," the County Court has approved the minutes of the meeting of Sept. 14, at which the King Electric Co. and the Suburban Electric Light & Power Co. were granted an extension of their franchises, jointly covering St. Louis County. Following the approving of the minutes, Paul Cable, Vice-Pres. of the King Electric Co. and the Suburban Electric Light & Power Co., stated that between $150,000 and $300,000 would be expended in constructing lines and other improvements.

FORT SAM HOUSTON, TEX.—Bids are asked at the office of L. J. Fleming, Constr. Q. M., until 11 a. m., Dec. 2, for the construction of an extension to the transmission lines of the electric lighting system at Fort Sam Houston and additional street lamps.

HUBBARD CITY, TEX.—We are officially advised that the Union Central Light & Ice Co., of Hubbard City, is about to make extensions to its present plant, in order to supply light, power, etc., to four surrounding towns. The company will erect a power-house, will install an ice machine and will make an addition to the water system. The company desires to communicate with contractors and engineers interested in the above propositions. Estimated cost, $75,000. E. S. Murphy is Supt., Hubbard City.

WALLA WALLA, WASH.—The City Council has passed an ordinance granting a franchise to the Washington-Oregon Trac-

tion Co. to erect and maintain an electric light and power plant and to build and operate appliances for the transmission of electricity for light, heat and power purposes.

HUSUM, WASH.—Preparations are being made by Martin & J. T. Thompson to install an electric power plant, to cost $10,000. Contracts for machinery have not yet been let.

NORTH YAKIMA, WASH.—Designed to furnish electric light and power to a chain of cities in the Yakima Valley from North Yakima to Kennewick and to operate the numbers of irrigation plants which have been and will be established in that territory, the Yakima Valley Power Co., of Spokane, has under construction a 90-mile high-tension line extending from its power plant on the Nachess River near Yakima to Pasco. The company, of which Robert E. Strahorn, Pres. of the North Coast Railroad, is the head, has purchased the power systems in Kennewick and Pasco and will furnish power for those cities as soon as the line is completed. The line is designed to convey 10,000 HP. From the plant to Pasco is 90 miles and the total length of the line will be 100 miles when various branches to nearby towns are built. Sub-stations on the line will be established at Toppenish, Grandview, Grandview, Mabton, Wapato, Kennewick and Pasco. To carry the current across the Columbia River between Kennewick and Pasco a 3-strand cable 3,000 ft. long, encased in lead, will be sunk to the bottom of the stream. The main line will be of aluminum wires on 50-ft. poles. The company will carry its own private telephone line on the same poles. The present capital of the company is $300,000. Its officers are Robert E. Strahorn, Pres.; R. J. Danson, Vice-Pres., and A. G. Smith, Secy. and Treas.

SAN FRANCISCO, CAL.—Bids are asked by the Supervisors until Nov. 18, for the fire system power stations, the pumps and turbines of the auxiliary plant. The total estimated cost amounts to $257,000.

PETALUMA, CAL.—Steps are being taken by the Town Trustees of Petaluma to procure a municipal gas plant. William E. Early, City Atty., has been instructed to draw up a resolution calling for a special election to bond the town for the proposed plant to cost $75,000. Another proposition which will be submitted at the same election will be a high pressure salt water pumping plant for fire protection, to cost about $25,000 and $10,000 municipal rock crushing plant for street improvements.

OAKLAND, CAL.—The central power station for the system of the Southern Pacific Co.'s lines about the East Bay Shore, when electricity is substituted for steam, is to be located at the foot of Fruitvale Ave. on the east side of the Tidal Canal. The site for the power plant has been acquired. Plans for the buildings and other accessories of the plant are being prepared. Application for franchises to substitute electricity for steam on the Southern Pacific lines in Alameda have been introduced and some of them have been granted. Others are pending and it is the intention of the Southern Pacific Co. to carry out its heretofore announced intention of proceeding as rapidly as practicable with the plan until all the lines in the north part of Alameda County have dispensed with steam. According to the plans of the directors of the road, the entire bay system will be converted into an electric railway and more than $2,000,000 will be spent in Berkeley alone making improvements. W. R. Scott is Supt.

OROVILLE, CAL.—It is stated that H. O. Lague and associates will erect a power plant in Plumas County. The locations call for 15,000 ins. of water on Nelson Creek, a like amount on Onion Valley Creek and 30,000 ins. on the middle fork of the Feather River at Bidwell Bar, making a total of 60,000 ins. The water from Nelson and Onion Valley Creeks is to be conveyed through Bald Rock Canyon.

SOLDIERS' HOME, CAL.—Bids are asked by E. W. Moore, Treas. Pacific Branch, N. H. D. V. S., Soldiers' Home, Los Angeles County, Cal., until noon, Nov. 20, for extension to power-house.

SAUSALITO, CAL.—The Marin Gas Co. has begun surveys for the purpose of locating a $45,000 gas plant in Sausalito. It is estimated that nearly $100,000 will be expended in construction of the plant and piping the town. A tank will be installed with a capacity of 1,000,000 cu. ft. As soon as Sausalito is piped mains will be run to Mill Valley.

GOLDFIELD, NEV.—Plans are now being completed for the construction of the proposed power plant of the Nevada-California Power Co. The company expects to be ready to receive bids for the construction of the plant about Feb. 1, which will include the construction of a power-house and dams, laying about two miles of wood-stave pipe, 3,000 to 4,000 ft. of steel pipe, and purchasing two or three 1,500 to 2,000 generators, with water turbines, transformers and other necessary equipment. D. A. Chappell, Denver, Colo., is Gen. Mgr. J. W. White, Goldfield, is Supt.

SANDPOINT, IDAHO.—Jerome L. Drumheller is interested in a project to develop the water-power of Moyie Falls on Moyie River and transmit electrical energy to Sandpoint for manufacturing plants. It is stated that 8,000 HP. may be developed.

LARDER LAKE, ONT.—It is stated that a syndicate has been granted the privilege of developing the large water power at Raven Lake, which is about three miles south of Larder Lake. Surveys and plans are being prepared, and J. Samson Handley, of New Liskeard, Ont., has been retained as Consulting Engr. for the scheme. The general outline of the scheme is to convert the power into electrical energy with a view of transmitting it to the various mines at Larder Lake over a high tension pole line.

BRIDGES.

(denotes that this work is advertised in Engineering News.)*

BELLOWS FALLS, VT.—The citizens have voted to construct a cement bridge over the canal, replacing the present iron structure. Estimated cost, $12,000.

RUSSELL, MASS.—JOHN DONAHUE, of Springfield, Mass., has been awarded the contract for filling in and grading the approaches and building the foundations for the new iron bridge here.

NEW YORK, N. Y.—Bids are asked by J. W. Stevenson, Comr. of Bridges, until 2 p. m., Nov. 19, for furnishing and delivering steel and hardware supplies to the Harlem River bridges during the year 1908; for furnishing and delivering lumber to Harlem River and Bronx bridges during the year 1908.

ROCHESTER, N. Y.—The State Bridge Engineer, Albany, is preparing plans for the Lyell Ave. and Allen St. bridges to be constructed over the Erie Canal. Estimated cost, $105,000. The contracts will soon be let.

HARTFORD, N. J.—P. J. BYRNE, Burlington, N. J., has been awarded the contract by the county, at $4,000, for constructing a bridge between Hartford and Madisonville.

RIDGEFIELD PARK (Hackensack post-office), N. J.—The Board of Chosen Freeholders on Nov. 2 voted to issue bonds for $158,000 to build a bridge across the Hackensack River at Ridgefield Park.

PITTSBURG, PA.—The citizens on Nov. 3 voted in favor of issuing bonds for bridges as follows: Rebuilding Larimer Ave. bridge, $175,000; new bridge at Meadow St., $65,000; new bridge at Everett St., $30,000; and new bridge over the Allegheny River at the Point, $1,000,000. N. S. Sprague is City Engr.

HUNTINGDON, PA.—Bids will be received until Nov. 12 by the County Commissioners, H. D. Taylor, Chn., for constructing an iron bridge across Big Trough Creek, Penn Township.

WILKES-BARRE, PA.—H. J. HARRISON has received the contract from the county for constructing two bridges in Huntington

MONONGAHELA, PA.—Bids are asked by F. P. Booth, County Controller, Allegheny County, and by the Commissioners of Washington County until noon Nov. 25, for the erection of a joint county bridge over the Monongahela River here. The bridge will have three 455-ft. spans carried on two concrete abutments and two stone river piers with pile and concrete foundations.

WASHINGTON, D. C.—The following bids were opened on Oct. 31 by the Commissioners of the District of Columbia, for building a concrete retaining wall in Eleventh St. S. E. along the west side of the north approach to the Anacostia Bridge: J. Paul Smith, $7,397; W. B. Bradley Co., $2,986; Lyons Bros., $4,800; W. A. Frye, $3,645; James Jenkins Overn, $4,948. Warren F. Brenizer, Second and Ohio Sts. S. E., $3,400.

NEWNAN, GA.—The Central of Georgia Ry. Co., C. K. Lawrence, Ch. Engr., Savannah, Ga., will construct a bridge over its tracks here.

AUGUSTA, GA.—The Council on Nov. 2 awarded the contract to J. H. McKENZIE'S SONS, of Augusta, for piers for a draw span at the Center St. bridge, at $20,880. Noted last week.

JACKSONVILLE, FLA.—The contract for constructing a steel bridge at Talleyrand Ave. has been awarded to the CONVERSE BRIDGE CO., of Chattanooga, Tenn., at $5,729. Bids were opened on Oct. 30 by the County Commissioners.

PALATKA, FLA.—We are officially advised that Putnam County on Nov. 3 voted for the issue of bonds for $190,000 for the following purposes: $55,000 for bridges; $100,000 for hard roads, and $35,000 for a courthouse. R. Raymond Price is County Engr.

MONTGOMERY, ALA.—The County Board of Revenue on Nov. 2 authorized the construction of a reinforced concrete bridge, 1,300-ft. span, across Catoma Creek on the Norman Bridge Road. Estimated cost, between $10,000 and $12,000. A. A. Gilchrist is City Engr.

DAYTON, OHIO.—The City Engineer will prepare plans and estimates for the construction of a bridge on Stewart St.

BRIDGEPORT, OHIO.—The CAPITAL CONSTRUCTION CO., Columbus, Ohio, has secured the contract at $9,864, for constructing a bridge over Wheeling Creek.

COLUMBUS, OHIO.—Bids are asked until noon, Dec. 16, by the Board of Public Service, for constructing the masonry approaches to and substructure of a viaduct over the tracks of the Hocking Valley and Toledo & Ohio Central Railways on Mound St. E. W. Hirsch is Secy. Bd.

CLEVELAND, OHIO. — The citizens on Nov. 3 voted in favor of issuing bonds for the construction of the Denison-Harvard bridge, connecting the south and west sides. Estimated cost, $460,000. The bridge will be built by the county.

DEFIANCE, OHIO.—The Board of Public Service on Nov. 2 awarded the contract to the TOLEDO-MASSILLON BRIDGE CO., Toledo, Ohio, for the construction of a lift-bridge over the Miami and Erie Canal at Fifth St., at $5,100.

PRINCETON, IND.—Bids are asked by the Board of Commissioners of Gibson County, until 11 a. m., Dec. 8, for the construction of 33 bridges.

ROCK ISLAND, ILL.—A. W. FREEMAN, Moline, Ill., has been awarded the contract at $5.70 per cu. yd., for placing 152 cu. yds. of concrete in the pier of the Milan bridge.

KEITHSBURG, ILL. — The UNION BRIDGE & CONSTRUCTION CO., of Kansas City, Mo., has secured the contract for the construction of a steel bridge over the Mississippi River here for the Iowa Central Ry. Co. Estimated cost, about $1,000,000.

DES MOINES, IOWA.—Plans have been prepared by the City Engineer for a culvert at East 30th and North Sts. It will be 310 ft. in length. Estimated cost, about $3,500.

ST. PAUL, MINN.—The St. Paul Bridge & Terminal Ry. Co., incorporated with a capital of $500,000, will construct a bridge at Deacon's Bluff over the Mississippi River. W. Magivny, Pres., Stock Yards Terminal Ry. Co., St. Paul, is interested.

LOUISVILLE, NEB.—The contract has been let to A. THOMPSON, of Omaha, Neb., for the construction of a wagon bridge across the Plate River here at about $15,000.

*KANSAS CITY, MO.—Bids will be received until noon, Dec. 7, at the office of the Commercial Improvement Co., 220 Dwight Bldg., for the manufacture and erection of the steel superstructure and concrete footings of a viaduct on Main St. Drawings and specifications can be obtained at the office of the company Nov. 16.

PAWNEE, OKLA.—Bids will be received about Nov. 23 for the construction of a bridge. John W. Griesel, of Pawnee, is Engr.

SPOKANE, WASH.—J. C. Ralston, City Engr., has estimated the cost of constructing a concrete bridge at East Oliver St., at $91,000. The plans provide for a structure 565 ft. long with a 40-ft. roadway and sidewalks 6-ft. wide, to be supported by four piers and two abutments.

The Board of Public Works on Oct. 19 opened bids as follows for furnishing 309,500 lbs. of steel to be used in the reinforcement of the concrete bridge at Mission Ave.: McGowan Bros., from $2.40 to $2.63 per 100 lbs.; F. T. CROWE & CO., $2.95 for "D" form bars (awarded contract), and $2.52 for round bars.

BARSTOW, CAL.—The C. G. SHEELY CO., 219 McPhee Bldg., Denver, Colo., was awarded the contract on Oct. 26 by the County Supervisors for the construction of the Mojave River bridge here at $8,792. Other bidders were: Mercereau Bridge Co., $11,440; John Gellegan Co., $9,642; John L. Brickels, $8,975; Union Iron Works, $10,927; Atlantic Gulf & Pacific Co., $10,347; C. B. & I. Works, $13,935; Joliet Bridge & Construction Co., $11,849.

VISALIA, CAL.—Bids will be received by H. J. Byrnes, Clk. Bd. of Trustees, until 7.30 p. m., Nov. 18, for furnishing of all labor and materials and construction and completion of cement bridge or culverts across Bridge St., Grove St., Northeast First St., Northwest First Ave., Encinal Ave., North Floral St., and Northwest St.

CENTERVILLE, CAL.—Bids are asked until 10 a. m., Nov. 16, by John P. Cook, County Clk., for replanking the trestle bridge on road leading from Alvarado to Centerville.

KAMIAH, IDAHO.—JOHN F. ARCHER & CO., of Spokane, Wash., have secured the contract for constructing a 735-ft. steel bridge here for the Kamiah Bridge Co., Ltd., at $17,000.

PRINCE RUPERT, B. C.—The cost of the bridge to be built by the Grand Trunk Pacific Ry. Co., near here to connect Kaien Island and the main land has been estimated at approximately $1,000,000. B. B. Kelliher is Ch. Engr., Montreal, Que.

BUILDINGS.

(denotes that this work is advertised in Engineering News.)*

PORTLAND, ME.—Carrere & Hastings, Archs., Fifth Ave. and 26th St., New York, N. Y., advise us that they have completed plans for a new city hall at Portland, to replace the structure which was burned last January. The estimated cost is $750,000. The main facade will be of light granite and will be in the form of a forecourt. An auditorium seating 2,000 persons is to be at the rear of the City Hall proper, and its floor will be on the street level, so that every window may serve as an exit. Marble wainscoting and terrazzo flooring are specified for hall and other public spaces. The roof is to be copper. The general quality of construction will conform to that in a high class office building. The work will be under the supervision of the Committee on the New City Hall, appointed by the City Council. Adam T. Leighton is Mayor. (This item was erroneously published last week under Portland, Ore.)

ANDOVER, MASS.—HARDY & COLE, of Andover, have secured the contract to erect tuberculosis buildings between Wilmington and Reading, Mass. The structures will comprise a state institution and will consist of eight separate brick buildings. Estimated cost, $50,000.

LYNN, MASS.—We are officially advised that competitive plans and specifications are being considered by the Board of School Commissioners, Charles H. Spear, Secy., for a 3-story brick school to contain 51,750 sq. ft. and to cost $85,000.

BOSTON, MASS.—The contract for enlarging the Suffolk County court-house by the addition of two stories has been awarded to the second lowest bidders, CONNERS BROS. CONSTRUCTION CO., 161 Plain St., Lowell, Mass. The contract price for the work is $692,345. James R. Dunbar, Joseph J. Corbett and William H. Wellington are Comrs. of Award. A complete list of bidders was published on Oct. 29.

NEW BEDFORD, MASS.—Preliminary sketches will be received by the City Council Committee on City Property, at office of W. H. B. Remington, Clk. of Committees, Library Bldg., until 4 p. m., Nov. 18, for the proposed high school building. Sketches to be furnished without cost to the city. Frank W. Francis is Chn.

FORT ANDREWS (Boston post-office), MASS.—The masonry contract for construction of a single set Field Officer's quarters, one 5-set Bachelor Officer's quarters, two double sets non-commissioned officers' quarters and on barrack for one company of coast artillery has been let to WILLIAM A. McCORMICK, of Newport, R. I., and not to C. E. Currier & Co., Boston, as erroneously stated last week.

DANBURY, CONN.—The H. WALES LINES CO., of Meriden, Conn., has secured the contract for the erection of the proposed 3-story hospital in Danbury and for an addition to the central heating plant of the Mt .Hermon school. The contracts will aggregate about $125,000. Hooper & Sunderland, New York, are Archs.

NEW YORK, N. Y.—We are officially advised that the Young Realty & Construction Co., 144th St., is taking estimates on six 6-story brick and stone apartment buildings to be built on 144th St., east of Broadway. Two buildings will be 100 × 86.7 ft. and four buildings will be 87.6 × 86.7 ft. The total frontage will be 550 ft. Thain & Thain, 4 East 42d St., are Archs.

Louis Korn, 253 Fifth Ave., and Maximilian Zipkes, 147 Fourth Ave., Archs., have filed plans for an 8-story loft building to be erected at 342 and 344 East 32d St., by J. Markowitz at a cost of $75,000.

Kuhn & Lawson, 508 West 142d St., will erect a 5-story flat building, 72 × 99.11 ft., on 161st St., 100 ft. east of Broadway, to cost about $80,000. Cocker & Martin Cooke, 2010 Fifth Ave., Archs., are preparing the plans.

NEW YORK, N. Y.—We are advised by Radcliff & Kelley, Archs., 3 West 29th St., that they will take estimates at once on a 6-story brick and stone, semi-fireproof warehouse, to face 34 ft. on Greenwich St., and 76 ft. on Canal St. The building will be constructed for Edward D. Depew, 14 Harrison St., and will cost $60,000.

L. F. J. Weiher, Arch., 103 East 125th St., is completing plans for the erection of a 6-story apartment block for the Broadway Construction Co., 516 West 162d St., to be erected on St. Nicholas Ave., between 158th and 159th Sts., at a cost of about $200,000. The building will cover an irregular plot. Excavating is going on, and the structural work will be started immediately.

The following bids were received on Nov. 2 by C. B. J. Snyder, Supt. School Bldgs., Dept. of Education, for installing heating and ventilating apparatus in new Public School No. 114, on James, Oak and Oliver Sts., Boro. of Manhattan: E. Rutzler Co., 127 White St., $51,565; Blake & Williams, 211 West 20th St., $48,284; Gillis & Geoghagan, 537 Broadway, $52,465; William J. Olvany, 177 Christopher St., $55,218; Frank Dobson Co., 319 East 53d St., $51,879; John Hankin & Bro., 550 West 25th St., $59,847; James Curran Mfg. Co., 512 West 36th St., $55,000; Raisler Heating Co., 1966 Broadway, $52,987.

Following are the bids received by Robert W. Hebberd, Comr. Dept. of Public Charities, for furnishing all labor and materials required for the erection and entire completion of iron balconies on the North Hospital (a) Ward 11, (b) Ward 14, and (c) Dormitory No. 2 at the New York City Children's Hospitals and Schools, Randall's Island: A. Winternitz, 237 East 72d St., informal; Garlitt Manning, (a) $18,250; (b) $24,300; (c) $30,400; A. S. Traub, (a) $11,122.28, (b) $14,330, (c) $17,871; J. & F. Walsh Co., (a) $10,755, (b) $14,253, (c) $17,793; George Hildebrand, 38 Park Row, (a) $12,200, (b) $16,500, (c) $20,500; J. M. Knopp, 270 West 19th St., (a) $12,400, (b) $18,467, (c) $20,543.

NEW YORK, N. Y.—The following bids were received on Nov. 2 by Nicholas J. Hayes, Fire Comr., for furnishing all the labor and materials required for the erection and completion of a new building for Engine Company No. 163 and Hook and Ladder Company No. 67, to be located on the south side of Flushing Ave., west of Twelfth Ave., Long Island City, Boro. of Queens: Concourse Construction Co., $63,784; Thomas Ceckerill & Sons, $61,600; J. F. Walsh Co., 1 Madison Ave., $59,700; R. Winternitz, 237 East 72d St., $59,620; Joseph Wagner, $55,850; Thomas J. Buckley Construction Co., Lexington Ave. and Hudson River, $61,831; Charles S. Peckworth, 415 Hudson St., $59,443; James F. Kerr, 205 West 30th St., $61,435; The Bettsford Dickinson Co., $58,158; Peter Guthy, $60,887; Ormond & O'Brien, $61,600; Howard C. Kelly Co., 271 West 125th St., $64,970; George Hilderbrand, 38 Park Row, $69,300; Ahern Construction Co., $69,800; O'Connell & Hanna, 271 West 125th St., $57,994; John F. Reilly, $56,800; Joseph B. Acker & Co., 59 Pearl St., $61,618; William Horne Co., 71 West 132d St., $63,200; Wilmarth Building Co., 1170 Broadway, $58,945; William Lehr, informal, $69,600.

Bids are asked by Nicholas J. Hayes, Fire Comr., until 10.30 a. m., Nov. 18, for furnishing all the labor and materials required for additions and alterations to the quarters of Hose Company No. 7, east side of Orchard St., south of Shelton Ave., Jamaica; for additions and alterations to the quarters of Hook and Ladder Company No. 75, Spruce St., north of Atlantic Ave., Richmond Hill; for additions and alterations to the quarters of Hook and Ladder Company No. 77, west side of Union Ave., south of Fulton St., Jamaica; for additions and alterations to the quarters of Hose Company No. 3, north side of Bandman Ave., west of Henry St., Jamaica; for additions and alterations to the quarters of Hose Company No. 4, east side of Rockaway Road, south of Fulton St., Jamaica; for additions and alterations to the quarters of Hose Company No. 5, west side of John St., north of Charles Pl., Jamaica; for additions and alterations to the quarters of Hose Company No. 6, west side of Herriman Ave., north of Fulton St., Jamaica.

NEW YORK, N. Y.—William Emerson, Arch., 281 Fifth Ave., advises us that he has awarded general contract to the H. D. BEST CO., 1170 Broadway, at $51,000, for the construction of a 6-story brick warehouse with stone trimmings. The building

will be 27.1 × 175.4 ft. and cost altogether about $60,000. Mr. Emerson will let the electrical and heating contracts.

R. Thomas Short, Arch., 2979 Fulton St., Brooklyn, is preparing plans for a 1-story mosque to be built in the Borough of Brooklyn, for Kismet Temple, Ancient Arabic Order of Mystic Shrine. Cost, $110,000.

Plans are about finished by J. E. Scharsmith, Arch., 1 Madison Ave., for two 6-story apartment houses which Jacob Herb, 198 Broadway, will erect at St. Nicholas Ave. 164th and 165d Sts., to cost about $290,000.

Plans have been filed with the Building Superintendent for a 5-story residence to be built for James B. Clews of Henry Clews & Co., bankers, at the corner of Fifth Ave. and 85th St. It will be of ornamental limestone, fronting 25 ft. on the avenue and 90 ft. on the street, and will be of the modern Italian design. The building is to cost $80,000.

WHITE PLAINS, N. Y.—The following bids were received by the State Armory Commission on Nov. 10 for the construction of a State Armory at White Plains, N. Y.: (1) for entire work; (2) will deduct if gas piping, electric wiring, etc., is omitted; (3) working days to complete. John W. Ferguson Co., Postal Telegraph Bldg., New York. (1) $123,000; (2) $1,500; (3) 200. The R. T. Ford Co., Rochester, N. Y., (1) $125,000; (2) $2,000. O'Connell & Hannan, 271 West 125th St., New York, (1) $118,100; (2) $1,300; (3) 300. John H. Parker Co., 42 East 23d St., New York, (1) $112,929; (2) $1,000; (3) 455. Charles Peckworth, 415 Hudson St., New York, (1) $127,159; (2) $1,675; (3) 250. Wilmarth Building Co., 1170 Broadway, New York, (1) $98,817; (2) $1,875; (3) 300. Morris Kantrowitz, Albany, N. Y., (1) $125,400; (2) $1,450; (3) 325. Rocco Briante, White Plains, N. Y., (1) $99,573; (3) 330. Feeney & Sheehan Building Co., Albany, N. Y., (1) $128,900; (2) $1,500; (3) 300. Attilio Pasquini, New York and Albany, (1) $120,649; (2) $1,400; (3) 250. William H. Luth Co., Brooklyn, N. Y., (1) $129,100; (2) $1,620; (3) 275. Nial Bros Construction Co., Troy, N. Y. (1) $110,907; (2) $1,450; (3) 425. John J. Turner, Amsterdam, N. Y., (1) $109,650; (2) $1,480; (3) 380. Peter Keeler Bldg. Co., Albany, N. Y., (1) $108,900; (2) $1,500; (3) 400. Collins Bros., Albany, N. Y., (1) $125,000; (2) $1,450; (3) $420. Major F. A. McNeeley is Secy. of Armory Comn. F. B. Ware is State Arch., Albany.

WHITE PLAINS, N. Y.—Ground will be broken soon for a 4-story brick store and office building which John Miles, of White Plains, is to erect on Martine Ave., between Court St. and Mamaroneck Ave. The first floor will contain stores and the other three stories will be fitted up into offices and apartments. The building will be over 200 ft. long and cost about $100,000. The contract has been let to the GLEN ENGINEERING CONSTRUCTION CO., of White Plains.

FORT HAMILTON, N. Y.—Bids are asked by the Constructing Quartermaster until 11 a. m., Dec. 1, for the construction, heating, plumbing and electrical wiring of one double set barracks, one double set noncommissioned officers' quarters and one double set of firemen's quarters.

BRONXVILLE, N. Y.—Edward L. Tilton, Arch., 32 Broadway, New York, is preparing plans and will receive estimates about Dec. 1 for buildings to be built at Bronxville, for the German Evangelical Lutheran Synod, care Rev. W. F. Koepchen, 431 West 43d St., New York. Cost, $120,000.

NEWARK, N. J.—Ernest F. Guilbert, Arch. for the Board of Education, has prepared preliminary plans for a 2-story brick gymnasium, adjoining the high school, to cost $50,000. He has completed plans also for a 7-story brick addition to the 14th Ave. School, to cost $54,000.

PHILADELPHIA, PA.—Jacob Disston and Dr. Joseph H. Ross, 106 West Susquehanna St., are preparing to build an apartment house at the corner of Chelten and Wayne Aves., Germantown. The plans have not been completed by Savery, Scheetz & Savery, Archs., Stephen Girard Bldg. The building will be eight stories high and will cost about $100,000, in addition to the investment in the lot.

On Nov. 6, contracts were awarded by the Board of Education for the immediate erection of two 24-division schools in the extreme northern and southern sections of the city, also to build two annexes to West Philadelphia school. PEOPLES BROS., 2510 Callowhill St., were awarded contract for the two new schools. Their bid for the Grover Cleveland School, to be erected in the 38th Section, at 19th and Butler Sts., was $174,425. The other bidders were Thomas Reilly, $197,864; B. Ketchum & Sons, $181,950; Sax & Abbott Co., $183,987; James G. Doak & Co., $177,762; Charles McCaul Co., $177,671; M. E. Dotts & Co., $182,733; Lynch Bros., $178,945; Mitchell Bros., $197,859.

With the bid of $170,987, PEOPLES BROS. secured the contract for the erection of the Anthony Wayne School, in the 39th Section, at 28th and Morris Sts. The other bidders were Thomas Reilly, $198,243; B. Ketcham & Sons, $177,395; Sax & Abbott Co., $187,427; W. E. Dotts & Co., $176,533; Lynch Bros., $172,542; Mitchell Bros., $194,402; Henry E. Baton, $182,171; The Charles McCaul Co., $173,948; Cramp & Co., $180,000; James G. Doak, $174,421. LYNCH BROS. James and Pratt Sts., were authorized to build two wings to the Thomas G. Morton School, 63d St. and Elmwood Ave., at a cost of $24,932.

Milligan & Weber, Archs., 520 Walnut St., have completed plans for an 8-story loft building suitable for printing establishments, to be built for Mershon Bros., at 233-35 South Third St. It will be constructed of reinforced concrete and terra cotta, and will be fireproof. The cost is expected to be close to $200,000. The site of the building measures 31 ft. on Third St., and has a depth of 195 ft., extending to South American St.

PHILADELPHIA, PA.—The competitive plans submitted by Lauer & Hahn, Archs., for the new building of the People's Trust Co., of Philadelphia, 1006 Arch St., which will be erected at the corner of Twelfth and Arch Sts., have been selected by the Board of Directors of the People's Trust Co. The building provided for in the plans of Sauer & Hahn will be ten stories in height, of concrete, with an exterior of brick and terra cotta. The first and second floors will be divided into offices for the use of the trust company. The remaining eight floors will be lofts, extending the whole length of the building, and constructed with a view to the needs of the wholesale trade. The cost of the building will be about $250,000. The lot on which it will stand has a front of 45 ft. on Arch St., with a depth of 132 ft.

PHILADELPHIA, PA.—W. H. Coakman, Arch., Pennsylvania R. R. Co., Philadelphia, advises us that the contract for constructing a steel and galvanized iron storage shed building with 40,000 sq. ft. floor space was let on Oct. 30 to ARMSTRONG & LATTA CO., Land Title Bldg., Philadelphia. Cost, $60,000. Noted last week under New York.

PHILADELPHIA, PA.—The All Saints' Protestant Episcopal Congregation, Rev. J. E. Hill, Rector, will erect a 1-story church, to cost from $50,000 to $75,000. The architect has not been selected.

Contract has been let to W. W. REA'S SONS, 1819 Francis St., for erection of the Italian Presbyterian Church at Tenth and Kimball Sts. It is to be of brick and stone and will cost $40,000.

HERBERT E. HAVENS, Stephen Girard Bldg., has secured the contract to erect a building for George Miller at 1306 Chestnut St. Ballinger & Perrot, 1200 Chestnut St., are Archs. The building will cost $45,000.

WASHINGTON, D. C.—Bids are asked until 2 p. m., Nov. 21, by Bernard R. Green, Supt. of Construction, for furnishing, delivering and installing in place complete, the white marble wainscoting, partitions and tiling of halls and lavatories, and the Tennessee marble tiling, stairs, strings and bases, etc., required in the new building for the National Museum in this city.

TAKOMA (Washington post-office), D. C.—Bids will be received by H. L. Pettus, Constr. Q. M., U. S. A., until Dec. 1 for completion of fourth floor, installing electric elevators and vacuum cleaning system at the Walter Reed Army General Hospital.

MARIETTA, GA.—The following bids were opened on Nov. 4 by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of the U. S. post-office, Marietta, Ga.: J. J. Keller & Co., Rock Hills, S. C., $52,580; time, July 1, 1909. Robert E. Pharrow, Atlanta, Ga., $47,345.77; time as specified. Gude & Walker, Atlanta, Ga., $47,600; time, one year. George A. Clayton, Atlanta, Ga., $48,962; time, one year. Miles & Brodt Co., Atlanta, Ga., $48,000; time as specified. King Lumber Co., Charlottesville, Va., $48,480; time as specified. Wilmarth Building Co., 1170 Broadway, New York, $42,549; time, July 31, 1909. Norcross Bros., Worcester, Mass., $54,400; time, eight months. Charles McCaul Co., Philadelphia, Pa., $48,493; time as specified. J. R. Edwards & Co., Rome, Ga., $52,400; time, Oct. 31, 1909. George Becking, Chattanooga, Tenn., $47,772; time, eight months.

PENSACOLA, FLA.—Estimates will be received about Nov. 15 by W. L. Stoddart, Arch., 33 East 17th St., New York, N. Y., for construction of an 8-story hotel for the Pensacola Hotel Co.

MARIETTA, OHIO.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, has awarded contract for the construction of the post-office at Marietta, Ohio, to WILLIAM F. HOLDING, 2426 Davidson Ave., New York, at $78,100. Time, Jan. 1, 1910. A complete list of bids was given on Oct. 22.

CAMBRIDGE, OHIO.—The Board of Education has let general contract to R. H. EVANS CO., Zanesville, Ohio, at $50,500, and heating and ventilating to BARTLETT BROS. CO., Cleveland, at $6,500, for the high school building. F. C. Hanna is Clerk; J. F. Orr, Arch.

TOLEDO, OHIO.—Bids were received as follows Nov. 10 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at Toledo, Ohio: Edward Henry, South Bend, Ind., $469,000; Henry Shenk Co., Erie, Pa., $329,955; Luyster & Lowes, Dayton, Ohio, $307,229; Miles & Bradt Co., Atlanta, Ga., $329,000; John G. Unkefer & Co., Minerva, Ohio, $329,887; James Kawson & Co., Iowa City, Iowa, $340,000; Henry J. Spicker Co., Toledo, Ohio, $328,738; Ambrose B. Stannard, St. James Bldg., New York, $292,883; Charles W. Gindele Co., Chicago, $308,400; Bedford Stone & Construction Co., Indianapolis, Ind., $308,000; A. Bentley & Sons Co., Toledo, Ohio, $294,349; Conners Bros. Co., Lowell, Mass., $343,000. Time, May 1, 1910.

CLEVELAND, OHIO.—Bids were received as follows Nov. 5, at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the interior finish of the Cleveland, Ohio, post-office: Ambrose B. Stannard, St. James Bldg., New York, $794,000; W. B. McAllister, 2165 East 31st St., Cleveland, Ohio, $822,500; Henry Shenk Co., Erie, Pa., $841,586; John Peirce Co., 90 West St., New York, $799,600; Conners Bros. Co., Lowell, Mass., $906,000. Time, 18 months.

INDIANAPOLIS, IND.—We are officially advised that the award for plans for the proposed city hall was made to Rubush & Hunter, Archs., American Central Life Bldg., Indianapolis, on Nov. 2. The structure will be erected at the corner of Alabama and Ohio Sts., and will cost $800,000. Charles G. Davis is Chn. Bldg. Com., Baldwin Block.

D. A. Bohlen & Son, Archs., Majestic Bldg., Indianapolis, have completed plans for a 4-story Masonic building for the Murat Temple Association. Cost, $350,000.

LEBANON, IND.—Bids are asked until Dec. 7 by the County Commissioners for remodeling the county jail and equipping cells with locks. B. H. Herdrich, County Audr.

MUNCIE, IND.—Bids are asked until Dec. 1, by the City, for erecting a 3-story municipal building, 115 × 125 ft., to cost $150,000. The building will be used by the Fire and Police Departments and city offices. Cuno Kibele, Johnson Bldg., Muncie, is Arch.

NORTH CHICAGO, ILL.—The following bids were opened Nov. 4 at the Navy Department for the construction of commanding officers' quarters, four officers' houses and one guardhouse at the new naval training station at North Chicago, Ill.: Northern Construction Co., 421 Milwaukee St., Milwaukee, Wis., construction complete, $135,000; alternate bid, $133,500. H. J. Cohlgraff & Co., 1130 Clark St., Chicago, Ill., $139,993. George Hunchliff, 707 Security Bldg., Chicago, Ill., commandant's house, $39,960; officers' houses, $76,560; guardhouse, $8,551, informal, no guaranty. Conners Bros. Co., Lowell, Mass., $156,332; alternate, $145,000. William J. Scown Building Co., 115 Dearborn St., Chicago, Ill., $133,000; alternate, $132,500.

*CHICAGO, ILL.—Bids were received on Nov. 2 by John J. Hanberg, Comr. of Public Works, for the general work required in connection with the construction of the proposed 12-story city-hall building to be erected on the west half of Block 39, original town of Chicago, according to plans and specifications of Holabird & Roche, Archs., Monadnock Block. The bidders and their prices on the general work, which includes the construction minus the caissons, the machinery and some of the fittings, are as follows: Alling Construction Co., 72 Madison St., Chicago, $3,333,333; Thompson-Starrett, Co., Fisher Bldg., Chicago, $3,373,600; George A. Fuller Co., $3,486,000; Wells Bros. Co., $3,437,000; John Griffiths & Son, $3,436,000; Noel Construction Co., German & Calvert Sts., Baltimore, Md., $3,295,000; William Grace Co., $3,524,000; George W. Jackson, Inc., $4,490,940; B. M. Zadeck Co., $3,499,707; M. H. McGovern, $3,843,636.

The next largest contract is for marble work, on which were the following bidders, with the bids of each: Hildgartner Marble Co., Sharp & Ostend Sts., Baltimore, Md., $503,939; C. H. Young Co., $439,000; Evans Marble Co., $516,000; John Peirce Co., 90 West St., New York, $471,000; Peoria Stone & Marble Works, $475,323; Chester W. Matthews Marble Co., $495,000; Andrews Stone & Marble Co., $508,693; Henry Marble Co., $523,420.

Three concerns bid on the electrical generator contract, the list being: Western Electric Co., 259 South Clinton St., Chicago, 4 245; Commonwealth Edison Co., $20,872; Westinghouse Electric Co., $25,794.

For the engines the following bids were received: Erie City Iron Works, First National Bank Bldg., Chicago, $30,164; George W. Jackson, Inc., $39,000; Allis-Chalmers Co., Milwaukee, $57,936; Ball Engine Co., $39,000; Ridgeway Dynamo & Engine Co., $32,930; C. & G. Cooper Co., $38,950.

The following bids were received for a system of pneumatic tubes; Lamson Consolidated Store Service Co., $2,264; Universal Pneumatic Transmission Co., $2,750; George W. Jackson, Inc., $3,500; United Store Service & Tube Co., Times Bldg., New York, $1,795; Single Tube Transmission Co., $2,275.

For the refrigerator system these bids were made: Creamery Package Mfg. Co., 184 East Kinzie St., Chicago, $7,434; Wishard-Berge Machine Works, $9,800; Fred W. Wolf Co., $7,300; Carbondale Machine Co., 79 Dearborn St., Chicago, $6,975.

For boilers the proposals were: Oil City Boiler Works, 39 Cortlandt St., New York, $27,250; Edge Moore Iron Co., $28,775; Babcock & Wilcox Co., $37,361; J. G. O'Neil, $35,109; George W. Jackson, Inc., $39,000; Heine Safety Boiler Co., $30,610.

Proposals for both hydraulic and electric elevators were invited, the bids being: Otis Elevator Co., 9 Jackson Boulevard, Chicago, and 17 Battery Pl., New York, electric, $108,000, hydraulic, $147,000; Kestner & Co., electric, $96,246.

The item of furnaces and grates showed a wide margin of prices as follows: Green Engineering Co., $6,210; George W. Jackson, Inc., $11,000; Rosedale Foundry & Machine Co., $8,379; Murphy Iron Works, $6,452; Hawley Down Draft Furnace Co., $9,250.

Two plans were proposed for pumps, tanks and high pressure piping, the figures received being: Gallaher & Speck, first plan, $21,185; second plan, $38,005; George W. Jackson, Inc., first plan, $34,000; second plan, $39,800; Hanley Casey Co., first plan, $23,850; second plan, $42,850; L. H. Prentice Co., first plan, $20,346; second plan, $32,832.

For electrical switches the bids were: Western Electric Co., $7,124; Cuthbert Electrical Mfg. Co., $8,271; J. Lang Electrical Co., $6,885; Westinghouse Electric Co., $5,409.

HINSDALE, ILL.—Patton & Miller, Archs., Hartford Bldg., Chicago, have let general contract to P. BARTZEL & SON, 2222 Lincoln Ave., Chicago, for additions to the South Side High School, to cost $75,000.

KENOSHA, WIS.—Competitive sketch plans and outline specifications will be received by the Building and Grounds Committee of the Board of Education until 8 p. m., Nov. 24, for a public school building. Cost of building, including architect's fee, must not exceed $60,000. J. E. Williams is Chn.

ST. PAUL, MINN.—Bids were received as follows Nov. 9 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, for the construction of a tower on the St. Paul post-office: Northern Construction Co., 421 Milwaukee St., Milwaukee, Wis., $144,883; P. M. Hennessey Construction Co., New York Life Bldg., St. Paul, Minn., $102,445; Butler Bros., St. Paul, $115,300.

*FORT MEADE, S. DAK. [illegible] are asked by Capt. L. C. Scherer, Con[illegible] Meade, until 10 a. m., [illegible] M. Fort for constructing three cavalry [illegible] for con- quartermaster storehouse, [illegible] and one plumbing, steam heating, [illegible] installing electric lighting fixtures in [illegible] ering and fied. [illegible] each specification.

ST. LOUIS, MO.—The [illegible] Library Board, at a recent meeting [illegible] approved the final drawings for the [illegible] which Lebrary, prepared by Helle[illegible] Archs., 721 Olive St., and [illegible] firm to advertise for bids. The building is to occupy the [illegible] and Soulard Sts., and will [illegible] park planned for that section. The new public bath-house. The modern renaissance style [illegible] brick and stone, with granite [illegible] will be of the "one-room type" so named because the main [illegible] one large reading room, surrounded [illegible] stacks 7½ ft. high. The [illegible] shelf room for 18,000 books. The scheme is arranged so as to [illegible] of natural light. In the basement [illegible] be an auditorium with a seating capacity of 400. There will also be [illegible] room for students, rooms for the staff. The building will cost $800,000.

William D. Ittner, Arch., [illegible] cation Bldg., is preparing plans for [illegible] school building, a 2-story [illegible] and an addition to school [illegible] Board of Education. They will cost $100,000, $150,000 and $70,000, respectively.

The Byr Investment Co., [illegible] will award contract about Dec. [illegible] of proposed apartment-house [illegible] three stories; 75 × 50 ft., of [illegible] stone, terra-cotta, tile and brick construction, with steam heating [illegible] laundry to be installed. Structure to contain 18 apartments. Cost, $[illegible]. Edward F. Nolte, 1101 Fullerton Bldg., St. Louis, is Arch.

DALLAS, ORE.—Plans for the new hotel which will be erected here by The Dallas Hotel Co. have been accepted. The structure, when completed, will cost between $80,000 and $100,000. It will be three stories high with a basement. The building will be 120 × 90 ft.

EUGENE, ORE.—Bids were received as follows Nov. 7 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, for the construction of a post-office at Eugene, Ore.: Campbell Bldg. Co., Dooly Block, Salt Lake City, Utah, $[illegible]; 540; W. O. Heckhart, Eugene, Ore., $[illegible]; George C. Mourer, Salem, Ore., $[illegible]; Welch Bros., Salem, Ore., $[illegible]; Charles A. Gray, Portland, Ore., $[illegible].

ONTARIO, CAL.—The general contract, excepting the plumbing, painting, electric work and heating of the new high school building to be erected at Ontario from the plans of John C. Austin, Wright & Calder Bldg., Los Angeles, has been let to Edward ERICK LUND, 730 Security Bldg., Los Angeles. The sub-contracts will be let [illegible].

LOS ANGELES, CAL.—A [illegible] Arch., H. W. Hellman Bldg., has received bids for the labor and material necessary to complete the church now under construction on West Adams St., near Hoover St., for the Second Church of Christ, Scientist. The bids were for the work as a whole, with the exception of glass, decorations, lighting fixtures, seating and general furnishings. They comprise the granite, concrete, sheet metal, skylights, painting, tile roofing, lathing, plastering, carpentry and woodwork, ornamental and ordinary iron work. The bids received were as follows: C. J. Kubach Co., Pacific Electric Bldg., $75,500; John S. Jacobs & Son Co., $75,917; Yard & Hichborn, Citizens' National Bank Bldg., $76,840; Paul Haupt, $77,691; Alta Planing Mill Co., $80,900; F. O. Engstrum Co., $81,200.

TORONTO, ONT.—Bids will be called about the middle of November for an 8-story steel and concrete hotel building to be erected corner of King and Simcoe Sts. for L. Sloman at an estimated cost of $100,000. Simpson & Young, 17 Toronto St., are Archs.

WATER SUPPLY—IRRIGATION.

(denotes that this work is advertised in Engineering News.)*

WALLINGFORD, VT.—Bids are asked until Nov. 14 by the Wallingford Water Co. for the construction of a water-works system consisting of a 30,000-gallon concrete reservoir and 2½ miles of pipe line. B. W. Aldrick, South Wallingford is Pres.

EASTHAMPTON, MASS.—The Water Commissioners have awarded to the BYRNE CONSTRUCTION CO., of New York, N. Y., the contract for laying a line of water pipe from the driven wells on Hendrick St. to the junction of Holyoke and Clark Sts., a distance of 1⅜ miles, at 22 cts. per ft. for 12-in. and 20 cts. per ft. for 6-in. pipe. Bids were opened on Oct. 29.

Bids will soon be asked by the Water Commissioners for the construction of the pumping station.

*SPRINGFIELD, MASS.—Bids are asked by the Board of Water Commissioners until 2 p. m., Dec. 4, for the construction of an earth dam as included under Little River Water Supply, Contract No. 5. F. E. Lochridge is Ch. Engr.

BROOKLYN, N. Y.—The T. A. GILLESPIE CO., Westinghouse Bldg., Pittsburg, Pa., was awarded the contract on Nov. 7 for the delivery, laying and completion within a year of 16 miles of water mains in the Borough of Brooklyn, at $2,000[illegible]. The steel for the pipe, it is understood, will be supplied by the National Tube Co. The pipe will be 6 ft. diameter.

SHERMAN, N. Y.—We are officially advised that F. T. BENSON & CO., Falconer, N. Y., was awarded the contract on Nov. 7 by the village at $15,377 for the construction of a water supply system. E. A. Wilder is Consult. Engr., Fredonia, N. Y.

*NEW YORK, N. Y.—Bids are asked until 11 a. m., Dec. 1, by the Board of Water Supply, 280 Broadway, New York, for construction of the north half of the Walkill Pressure Tunnel. J. Waldo Smith is Ch. Engr.

JAMESTOWN, N. Y.—The Erie R. R. Co. will erect a new 70,000-gallon pumping station to supply water to the locomotives. A 12-in. water main will be laid 1,200 ft. to the waterway now being built, which connects with the lake.

JERSEY CITY, N. J.—The Street and Water Board has adopted plans for a pump to be placed at or near North St. to drive the Boonton water to the upper stories of the Hudson City buildings. The pump is to be in operation in about a month. J. W. Griffin is Engr.-in-charge.

NORTH BETHLEHEM, (Bethlehem post-office), PA.—The Borough of Bethlehem will probably lay a pipe line and supply North Bethlehem with water. R. E. Neumeyer is Engr., Bethlehem.

CATASAUQUA, PA.—The citizens have voted to issue $80,000 of bonds for the construction of water-works. Bascom & Sieger, of Allentown, Pa., are Engrs.

PITTSBURG, PA.—The citizens on Nov. 3 voted in favor of issuing bonds for purchasing and improving the plant of the Monongahela Water Co. at a cost of $2,675,000 and for laying a water main in East End, to cost $300,000.

*READING, PA.—Bids will be received by the Board of Water Commissions until 7.30 p. m., Nov. 24, for building about 8,000 ft. of 60-in. reinforced conduit and appurtenances for raw water for Maiden Creek sand filters. Lincoln S. Ramsey is Secy. Bd.

BALTIMORE, MD.—The Board of Estimate on Nov. 3 approved the $5,000,000 water loan for a reservoir in Gunpowder Valley to supply Baltimore with drinking water. B. T. Fendall is City Engr.

*WASHINGTON, D. C.—Bids will be received by the Commissioners of the District of Columbia until noon, Nov. 21, for an auxiliary water system and fire protection for the Home for the Aged and Infirm, subdivisions of Bellevue and Blue Plains, District of Columbia.

RICHMOND, VA.—We are officially advised that JAVI PERKINS, 2307 West Main St., Richmond, was awarded the contract by the city at $6,460 for constructing a brick pumping station at the new powerhouse.

DRAVO-DOYLE CO., Lewis Block, Pittsburg, Pa., secured the contract at $14,550 for centrifugal pump and connections and the WESTINGHOUSE ELECTRIC & MFG. CO., American National Bank Bldg., Richmond, at $7,475, for electric work and fixtures. E. E. Davis is Supt. W.-Wks.

NORTHFORK, W. VA.—The Northfork Realty Co. is preparing plans for waterworks for townsite development.

BAMBERG, S. C.—Estimates are being prepared for the construction of waterworks here. Estimated cost, $7,000.

EAST POINT, GA.—The citizens voted on Oct. 28 to issue $85,000 of bonds for the construction of water-works, a sewerage system and an electric light plant. E. H. Davis, Griffin, Ga., is Engr.

PASCAGOULA (Scranton post-office), MISS.—The city has awarded the contract to the PASCAGOULA ST. RY. & POWER CO. for the extension of water mains to northern suburbs. L. G. Adams is City Clk.

NEW ORLEANS, LA.—The Consolidated Land Co., J. T. Delehan, Secy., 1023 Canal St., New Orleans, contemplates expending about $15,000 for the construction of waterworks and sewerage system. R. C. Huston, 726 Maison Blanch Bldg., New Orleans, is Engr.-in-Charge.

MADISON, OHIO.—The Riggs & Sherman Co., of Toledo, Ohio, has been selected to design and superintend the construction of water-works and a sewage disposal plant for the Soldiers' and Sailors' Widows' Home here.

SHAWNEE, OHIO.—We are officially advised that bids were received as follows by the city for furnishing and laying c.-i. water pipe, etc.: Richards Plumbing Co., Columbus, Ohio, $10,315; U. S. Construction Co., Columbus, $8,358; Pittsburg Construction Co., Leasdale, Pa., $10,699. Bradbury & Shute, Columbus, are Engrs.

DAYTON, OHIO.—The T. J. BACKUS CONSTRUCTION CO., Dayton, was awarded the contract by the Board of Public Service on Oct. 30 for the erection of the North Dayton pumping station, at $8,700. William Budroe is Clk. Bd.

NATIONAL MILITARY HOME, IND.—Bids will be received until Nov. 14 by J. W. Sanderson, Treas. Marion Branch, N. H. D. V. S., National Military Home, for the installation of a water softening and purifying plant here.

GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works, George C. Pierce, Pres., until Nov. 19 for the construction, delivery and erection at the waterworks pumping station of a vertical triple-expansion pumping engine, with a capacity of 12,000,000 gallons daily.

KEWANEE, ILL.—B. C. PARKINSON & CO., Kewanee, have been awarded the contract by the Board of Local Improvements at $3,711, for laying a water main. Bids were opened on Oct. 20. List of bidders noted last week.

*YORKVILLE, ILL.—Bids are asked until 8 p. m., Dec. 1, by the Village Board for constructing a concrete reservoir. H. D. Hallett, Aurora, Ill., is Engr.

SPIRIT LAKE, IOWA.—Bids will be received by the town until Nov. 17 for a complete water-works system, the work to comprise a 75,000-gallon steel tank and steel tower, distribution pipe line system, small cement block building, motor-driven pump and system of drive points. Estimated cost, about $20,000. A. W. Osborne is Town Clk. O. Claussen is Consult. Engr., German-American Bank Bldg., St. Paul, Minn.

COUNCIL BLUFFS, IOWA.—The citizens on Oct. 27 voted to issue $600,000 bonds for the purchase or construction of a municipal water-works plant.

NEW ULM, MINN.—Bids will be received by Ernst Wicherski, City Clk., until Nov. 16 for furnishing about 5,200 ft. of pipe, gates and valves, hydrants, etc., for pipe line on Center St. H. T. Bloomquist is City Engr.

BALDWIN, KAN.—The citizens voted on Oct. 26 to issue $85,000 bonds for the construction of water-works.

*HELENA, MONT.—Bids were opened on Oct. 29 by the city for furnishing material and constructing a water-works system, reservoir pipe line and distribution system for the city, the work to consist of approximately ten miles of wooden conduit, 40 miles of c.-i. mains, 250 hydrants, 400 gate valves, specials, etc., and a storage reservoir with a capacity of approximately 5,000,000 gallons, together with all appurtenances. The contract was awarded to the AMERICAN LIGHT & WATER CO., of Kansas City, Mo., at $529,970. Other bidders were: P. Moran, Salt Lake City, Utah, $572,323; Jacobsen & Bade Co., Portland, Ore., $570,000; J. Kennedy, Fargo, N. D., $554,960; Katz-Craig Co., Omaha, Neb., $541,275. Charles W. Helmick is City Engr.

GLENDIVE, MONT.—The Secretary of the Interior has awarded the contract to MICHAEL O. NEILL, Shoshone, Idaho, for delivering to the Dodson dam site, on Milk River project, Mont., from 1,000 to 2,000 cords of rock as needed by the Reclamation Service. The bid is at the rate of $4.45 per cord and is the lowest of seven received.

MARSHALL, TEX.—The city has awarded the contract to the TEXAS BITULITHIC CO., Dallas, Tex., at $5,500 for laying water mains and other pipes on various streets.

CORPUS CHRISTI, TEX.—The city has voted $37,500 of bonds to purchase the water-works plant. O. O. Wright is City Secy.

*DALLAS, TEX.—Bids will be received by J. B. Winslett, City Secy., until 3 p. m., Nov. 20, for furnishing one carload of valves, f. o. b. Dallas, two sluice gates, 30 ins. wide × 60 ins. high; two 30-in. gate valves, low pressure; four 24-in. gate valves, high pressure; four 20-in. gate valves, high pressure; one 8-in. gate valve, low pressure; fifty-six 6-in. gate valves, high pressure; three 18-in. valves, high pressure; six 16-in. valves, same; eight 12-in. valves, same; fourteen 10-in. valves, same; six 8-in. valves, same; six 4-in. valves, same.

HUBBARD CITY, TEX.—See item under Light and Power Plants.

LAMAR, COLO.—Bids are asked until 8 p. m., Nov. 16, by Charles Maxwell, Mayor, for constructing section No. 1 of the Lamar water-works, the work consisting of the construction of a dry rubble subterranean collecting gallery of small cross-section and the construction of 3,200 lin. ft. of 12-in pipe line.

LAS ANIMAS, COLO.—Bids will be received by Ida Z. Loudy, Town Clk., until Nov. 23 for furnishing material and improving water-works, to consist of a new pumping plant and equipment, steel tank or standpipe, and extension and addition to present mains, approximating 23,000 lin. ft. c.-i. pipe. Bids were asked until Nov. 9. The W. K. Palmer Co., Kansas City, Mo., are Engrs. W. R. Murphy is Town Engr.

HILLYARD, WASH.—The citizens on Oct. 27 voted to issue $35,000 of bonds for the construction of municipal water-works. R. E. Brown, of Hillyard, is Engr.; B. G. Sheire is City Clk.

OAKLAND, CAL.—The contract for the construction of the auxiliary salt water pumping plant on the shores of Lake Merritt has been awarded to the HEALY-TIBBITS CONSTRUCTION CO., 208 Market St., San Francisco, Cal., at $21,830.

PETALUMA, CAL.—See item under Light and Power Plants.

RENO, NEV.—A reclamation project is about to be started in Lincoln County, the company to be known as the Nevada-Utah Irrigation & Development Co. The undertaking includes the construction of a dam, ditches and laterals, estimated to cost $550,000. The promoters are Salt Lake City capitalists associated with the Salt Lake, Los Angeles & San Pedro R. R. Co., known as the Clark route. The total number of acres to be reclaimed is 23,333. The dam will be constructed at the head of Arrowhead canyon and will have a width of 670 ft. and a height of 185 ft. Frank Nicholas, State Engr., is interested.

VANCOUVER, B. C.—The Civic Water Committee have received bids as follows for the pipe necessary for the extension of the Seymour Creek mains to Little Mountain, and for the city extensions for the year: For the steel mains, including 10,000 ft. of 18-in., 17,000 ft. 16-in., 10,000 ft. 18-in. and 1,500 ft. heavy 18-in.: Evans, Coleman & Evans, $70,855 and $64,155, the prices being on different grades of lapwelded steel; THOMAS PIGGOTT, of Glasgow, Scotland, per W. Beverly Robinson, $59,939 for lapwelded (awarded contract); John Inglis Co., $96,815 for riveted main; A. J. Forsyth, $58,-151 for riveted main; Munderloh & Co., $69,835 for lapwelded; Robertson & Godson, $72,804 and $72,608, both prices on lapwelded; Vancouver Engineering Works, $62,-850 on riveted and $69,900 on lapwelded; Robert Ward, $72,605 on lapwelded; Crane & Co., $82,295 on Matheson joint pipe; C. Gardiner Johnson & Co., $79,165 on lapwelded. For the c.-i. pipe, 10,000 ft. 4-in., 30,000 ft. 6-in., and 10,000 ft. 8-in.: Canadian General Electric Co., $33,320; W Beverly Robinson, $30,019; C. W. Stancliffe, $31,077; C. Gardiner Johnson, $31,670; A. J. Forsyth, $29,491; Vancouver Engineering Works, $31,247; EVANS, COLEMAN & EVANS, $29,862 (awarded contract); Robertson Godson Co., $30,240; Munderloh & Co., special steel, $26,700. For 1,000 ft. of pipe for the submerged main at Second Narrows, EVANS, COLEMAN & EVANS submitted the lowest bid at $44 per ton and was awarded the contract. For 100 Ludlow hydrants the award was made to the ROBERTSON-GODSON CO., at $40.50 each, and the same firm secured the contract for pig lead at $3.64 per 100 lbs.

MOOSEJAW, SASK.—The ratepayers have passed by-laws for water and sewer extensions. Estimated cost, $40,000.

SEWERAGE.

(denotes that this work is advertised in Engineering News.)*

LONG ISLAND CITY (L. I.), N. Y.—Bids were opened on Oct. 27 by Lawrence Gresser, Pres. Boro. of Queens, for constructing sewers in portions of 17th Ave. The contract has been awarded to the GORE ENGINEERING & CONTRACTING CO., 206 Broadway, New York, at $10,129. List of bidders noted last week.

*RYE, N. Y.—All bids opened on Oct. 28, by the city for the construction of sanitary sewers and a sewage disposal plant have been rejected. New bids will be received by the Village Trustees until Nov. 18. G. Everett Hill, 156 5th Ave., New York, is Engr.

SCHENECTADY, N. Y.—The Board of Contract & Supply on Nov. 4 awarded the contract to KELLAM & SHAFFER, Maxon Road, Schenectady, for the construction of a sewer from Glenwood to Parkwood Boulevards. Charles W. Trumbull is City Engr.

*MAMARONECK, N. Y.—Bids are asked by the Board of Trustees until 8.30 p. m., Nov. 18, for about 1,182 ft. of sewers. Plans, etc., may be seen at the offices of Charles W. Buckter, Clk., and the Engineer, 5 Court St., White Plains, N. Y.

BUFFALO, N. Y.—Resolutions have been adopted by the Council for the construction of sewers in several streets. Francis G. Ward is Comr. Pub. Wks.

BROOKLYN, N. Y.—Bids are asked until 11 a. m., Nov. 18, by Bird S. Coler, Pres. Boro. of Brooklyn, for the construction of sewers and sewer basins in various streets.

YONKERS, N. Y.—FRED E. GROSS was awarded the contract on Nov. 2 by the Board of Contract and Supply for the construction of a sewer in Sherwood Ave., at $8,890. Other bidders were: Charlton & Weston, $9,000; O'Connor-McIntire Co., $9,-455; Kelly & Hannifin, $9,698; McDonald & Murray, $10,700; Thomas Grady, $10,775; M. J. Callahan, $13,000; Fisher & Cozzo, $16,-683.

LONG ISLAND CITY (L. I.), N. Y.—Bids are asked until 11 a. m., Nov. 24, by Lawrence Gresser, Pres. Boro. of Queens, for constructing sewers and appurtenances, temporary sewers, a receiving basin, and temporary catch-basins in various streets.

NEW BRUNSWICK, N. J.—Contracts for the construction of sewers in Delevan St., between Jones and Throop Aves., and in Comstock St., between Commercial and Jones Aves., were awarded to JOHN F. KERWIN and JAMES LYONS by the Common Council on Nov. 4. The bids were as follows: John Van Deursen, 8-in. pipe in Delevan St., $1.05 per lin. ft; in Comstock St., 80 cts. per lin. ft.; manholes, $35 each; 5-in. Y branches, 35 cts. each. Abraham Jelin, 8-in. pipe in Delevan St., $1.30; in Comstock St., $1.09; manholes, $30 each; 5-in Y branches, 50 cts. each. Patrick J. Moran, 8-in pipe in Delevan St., $1.05; in Comstock St., 91 cts.; manholes, $48 each; 5-in. Y branches, 75 cts. John F. Kerwin, 8-in. pipe in Delevan St., 99 cts.; in Comstock St., 85 cts.; manholes, $45 each; 5-in. Y branches, 65 cts. James Lyons, 8-in. pipe in Delevan St., $1.15; in Comstock St., 73½ cts.; manholes, $39.50 each; 5-in. Y branches, 50 cts. each. James Sheehan, 8-in. pipe in Delevan St., $1.08; in Comstock St., $1.06; manholes, $42 each; 5-in. Y branches, 30 cts. Frederick Schneider is City Engr.

*EAST RUTHERFORD (Rutherford post-office), N. J.—Bids will be received by the Sewer Committee until 8 p. m., Nov. 23, for the completion of the sewerage system and sewage disposal plant. Wise & Watson are Boro. Engrs., Rutherford, N. J.

DERRY, PA.—Bids will be received until Nov. 16 by J. N. Nicholson, Boro. Clk., for constructing 37,570 ft. of sewers. J. J. Neel is Boro. Engr., Greensburg, Pa.

FREEPORT, PA.—The Council has decided to have plans and specifications for a sewage system prepared at once. This is in accordance with the instructions of the State Health Commissioner.

SOUTHMONT (Johnstown post-office), PA.—C. P. Collins, Johnstown, Pa., has prepared plans for disposal systems for this place, providing both for surface drainage and house sewage. The outlet of the system will be at sewage filtration and sedimentation beds of the most approved type, and at a distance of about a mile from the town.

ELWOOD CITY, PA.—The State Health Department has approved the plans prepared for the construction of an intercepting sewer and sewage disposal plant, by R. Winthrop Pratt, Consult. Engr. The plans call for an intercepting sewer from Clyde St. to the site of the proposed disposal plant. The disposal plant will be built along the creek 35 ft. above high water and 100 ft. below the level of the town. It will be entirely of concrete, and will consist of the following: Screen chamber, 6 × 11 ft. and 4 ft. deep; three settling tanks, each 10 × 100 ft. and 11 ft. deep below the maximum flow line; gravel sludge bed with an area of 1,000 sq. ft.; six weirs of brass, each 2 ft. long; syphon chamber, 3 ft. deep, 10 ft. wide and 17 ft. long; two sprinkling filters, each 65 × 161 ft. with filtering beds from 4½ to 6½ ft. deep; five terraces with sprinkling nozzles and a sedimentation basin 60 × 30 ft. and 5 ft. deep. The entire plant will be about 700 ft. in length.

*PHILADELPHIA, PA.—Contracts for constructing branch sewers, bids opened on Oct. 14 by the Department of Public Works, George S. Webster, Ch. Engr., have been awarded to the following: JAMES A. MULLEN, 5512 Vine St.; THOMAS V. MONAGHAN, 4240 North 13th St.; LOMBARDI & PASENZZI, 601 Betz Bldg.; DONATO DELISE, 3316 North Lawrence St.; GEORGE E. CANTRELL, 112 South Fourth St.; DAVID McMAHON, East Chelton Ave.; PATRICK DURKIN, 2350 North Seventh St.; JOSEPH MOSS, 1652 Wakeling St.; ROBERT P. RYAN, 2116 North 30th St.; JOHN F. McNICHOL, 920 Betz Bldg.; RICHARD BENNIS, 710 East Chelten Ave.; JOSEPH PERNA, 334 North 6th St. Total cost, $100,150. George R. Stearns is Dir. Pub. Wks.

WILKES-BARRE, PA.—The following are the bids opened on Oct. 26 for the construction of 1½ miles of brick sewer: Stephen Flanagan & Son, Scranton, Pa., $135,511; King, Rice & Ganey, Weehawken, N. J., $137,290; Booth & Flynn, Ltd., Pittsburg, Pa., $135,974; Richard P. Bennis, East Chelten Ave., Philadelphia, $133,942; Gore-Meenan Co., New York, N. Y., $127,310; D. M. Rosser Engineering & Construction Co., Wilkes-Barre, $119,985; C. M. Reilly, Wilkes-Barre, $178,844; Joseph Hendler & Co., Wilkes-Barre, $161,742; James Duff Contracting Co., Cleveland, Ohio, $168,811; Millard Construction Co., Philadelphia, Pa., $174,533; David Peoples, Betz Bldg., Philadelphia, Pa., $166,420. All the bids have been rejected as excessive. B. K. Finch is City Engr.

ALTOONA, PA.—We are officially advised that the contract for the construction of 800 ft. of 8-in. sewers has been awarded by the Board of Public Works to WILLIAM HERR SONS. J. B. Andrews is Chn. Bd.

POLK, PA.—Bids will be received by the Board of Trustees of the State Institution for Feeble-Minded of Western Pennsylvania, at the institution, Polk, until 3 p. m., Nov. 23, for the construction of a sewer system and sewage disposal plant for the institution. Plans and specifications on file at the institution and at the office of the Department of Health, Harrisburg, Pa. The sewers and disposal plant will be constructed under separate contracts. Work on the disposal plant will consist of 5,700 cu. yds. of excavation, 1,000 cu. yds. of concrete, a part of which is reinforced, 30 tons of c.-i. pipe and specials and 3,500 ft. of sewer pipe, with all connections and appurtenances. Work on the sewer system will consist of two miles of sewers, 6 ins. × 12 ins. in diameter, 27 concrete manholes and appurtenances for the sewer system. John A. Wiley is Secy. Bd.; J. M. Murdoch is Supt.

BALTIMORE, MD.—The Sewerage Commission is planning to erect a temporary disposal plant west of Garrison Ave. in order to give Forest Park a system of sanitary drainage. Estimated cost, about $100,-000. B. T. Fendall is City Engr.

WASHINGTON, D. C.—E. G. GUMMEL, of Washington, has secured the contract for constructing the Congress Heights trunk sewer, bids opened on Nov. 2, at $5,650. Asa E. Phillips is Supt. of Sewers.

ROANOKE, VA.—Bids are asked until noon, Nov. 21, by R. H. Wills, City Clk., for constructing two sewers. W. B. Bates is City Engr.

NORTHFORK, W. VA.—The Northfork Realty Co. is preparing plans for a sewerage system for townsite development.

EAST POINT, GA.—See item under Water Supply—Irrigation.

JACKSON, MISS.—The WEST CONSTRUCTION CO., Chattanooga, Tenn., was awarded the contract on Sept. 27 by the Board of Mayor and Aldermen for the construction of a storm sewer in South Royal St., at $6,055. Hamilton Johnston is City Engr.

NEW ORLEANS, LA.—The Consolidated Land Co., J. T. Delehan, Secy., 1023 Canal St., will construct a sewer system and water-works system. Estimated cost, about $15,000. R. C. Huston, 726 Maison Blanch Bldg., New Orleans, is Engr.-in-Charge.

BOWLING GREEN, KY.—The Council has directed that estimates be prepared for the construction of sewers. Cost, about $15,000.

LOUISVILLE, KY.—The Sewerage Commissioners on Oct. 30 authorized the preparation of plans for the construction of Section F of the southern outfall sewer. J. B. F. Breed is Ch. Engr.

JEFFERSON, OHIO.—WILLIAM BATCHELOR, Conneaut, Ohio, has been awarded the contract at $4,787, for constructing sewer for the county.

SANDUSKY, OHIO.—The Council has passed an ordinance to enlarge the Scott St. sewer, and construct a sewer in Cable Park addition. Estimated cost, $5,000. Clifford M. King is City Engr.

MOUNT GILEAD, OHIO.—W. B. Eells, of Mount Gilead, is preparing plans for the construction of pipe sewers. Estimated cost, about $26,000. Bids will probably not be called for until spring.

DAYTON, OHIO.—Bids will be received by the Clerk of the Board of Public Service until noon, Nov. 20, for constructing sanitary sewers in a portion of district No. 9, Stillwater Ave., from Mary Ave. to corporation line; Ridge Ave., from Stillwater Ave. to Glenwood Ave.; Hudson Ave., from Stillwater Ave. to Main St., 3,800 lin. ft. of 8-in. vitrified pipe, 10 lin. ft. of lead pipe with trench, excavation and back fill, 200 lin. ft. of 6-ft. and less cut, 2,580 lin. ft. of 6-ft to 8-ft. cut, 1,020 lin. ft. of 8-ft to 10-ft. cut, ten manholes, one lamphole, one flush tank, one corporation cock and specials. J. C. Ely is Pres. Bd.

*WYOMING, OHIO.—We are officially advised that bids were received as follows on Nov. 4 by the village for the construction of a sewage disposal plant, and about 22,-569 ft. of sanitary sewers, with the necessary appurtenances, the size of sewers ranging from 8 ins. to 18 ins. in diameter, all to be of double strength vitrified pipe; (a) without disposal plant, (b) with disposal

plant, electric motor, (c) water motor: Scott & Walker, Cincinnati, Ohio, (a) $25,002; Thomas P. Strack, 28 Goodall Bldg., Cincinnati, (b) $32,005, (c) $32,005; Evan Evans, Cincinnati, (b) $46,928, (c) $46,728; Kirchner Construction Co., Eighth and Plum Sts., Cincinnati, (b) $47,895, (c) $47,765; Walter S. Hollander, 1330 Race St., Cincinnati, (b) $40,115; Bosler & Flynn, Chattanooga, Tenn., (b) $47,000, (c) $46,990; C. S. Lambie Co., 331 Fourth Ave., Pittsburg, Pa., (b) $39,255 (c) $39,255; T. J. Backus Construction Co., Dayton, Ohio, (b) $44,655, (c) $44,689. The Riggs & Sherman Co., Toledo, Ohio, are Engrs. Itemized list of bids is given under Contract Prices.

COLUMBUS, OHIO.—The C. T. McCRACKEN CO. was awarded the contract on Nov. 2 by the city for the construction of the Scott St. storm sewer at $17,779. Henry Maetzel is City Engr.

CLEVELAND, OHIO. — Contracts were awarded on Nov. 2 by the Board of Public Service for the construction of the Morgana Ave., S. E. and East 40th St. sewers to WALTER P. GRIBBEN and CHRISTIAN BURKHARDT. Cost, about $30,000. W. J. Springborn is Pres. Bd.

YOUNGSTOWN, OHIO.—J. M. REED, of this city, has been awarded the contract for the construction of a sewer from Robinson Road through the city and across the railroad yards to the Mahoning River.

INDIANAPOLIS, IND.—The following bids were opened by the Board of Public Works on Oct. 30 for the construction of the Brightwood sewer system: JOHN JENKINS, 1531 Lewis St., $9.03 per lin. ft. (awarded contract); Mansfield Engineering Co., $10.29; Sheehan Construction Co., $10.72; American Construction Co., $11.42; William Yates & Co., $11.48.

R. T. PICKENS has secured the contract for constructing a circular sewer 4 ft. 6 ins., in Sherman Drive, at about $6,000. Blaine H. Miller is City Engr.

INDIANAPOLIS, IND.—Bids are asked by the Board of Public Works until Nov. 26 for the construction of a sewer in Layman St., a sewer between New York and Michigan Sts., a sewer in Dearborn St., and for a market house sewer system. Blaine H. Miller is City Engr.

GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works, George C. Pierce, Pres., until Nov. 27, for sewage pumping machinery, consisting of four 40-in. four 24-in., and two 18-in. centrifugal pumps, four 175-HP., two 75-HP., two 60-HP., and three 30-HP. electric motors, together with vacuum pumps, piping, etc. L. W. Anderson is City Engr.

Bids are asked by the Board of Public Works until 8 p. m., Nov. 12, for furnishing and erecting a sewage pumping station on the west side ditch sewer.

SPOKANE, WASH.—JOHN FIFE has been awarded the contract for constructing subsewer in the First Ward, district No. 12, at $12,844, and for a trunk sewer in the Fifth Ward, district No. 2, at $5,444. Bids were opened on Oct. 22.

The following are the bids opened on Oct. 22 by the Board of Public Works for constructing the sub trunk sewer in the First Ward, district No. 9: JOHN FIFE, $51,744 (awarded contract); Julia V. Costello, $73,860; G. Burgie, $74,965; Naylor & Norlen, $58,000.

The following are the bids opened on Oct. 22, for a trunk sewer, Fifth Ward, district No. 1: NAYLOR & NORDEN, $61,900 (awarded contract); John Fife, $73,644; Julia V. Costello, $90,217; G. Burgie, $91,965.

BELLINGHAM, WASH.—The contract for the construction of the Champion St. sewer tunnel was awarded on Oct. 27 by the Board of Public Works to ARTHUR S. BENT, of Los Angeles, Cal., at $24,356, about $1,000 below the estimated cost.

SEATTLE, WASH.—Bids are asked until Nov. 14 by the Board of Public Works for constructing the middle section of the north trunk sewer. This section will extend from the Green Lake Section to a point near Ross.

EL CENTRO, CAL.—The city has voted $40,000 for the construction of a sewer system.

MOOSEJAW, SASK.—See item under Water Supply—Irrigation.

GARBAGE DISPOSAL.

NEW YORK, N. Y.—Bids are asked by the Commissioner of Street Cleaning until noon, Nov. 20, for the collection and removal of all ashes, garbage and other light refuse and rubbish in specified districts of the Borough of the Bronx, and Inwood and Marble Hill in the Borough of Manhattan.

PITTSBURG, PA.—The citizens on Nov. 3 voted in favor of issuing $185,000 bonds for building and equipping incinerating plants for the disposal of rubbish.

MILWAUKEE, WIS.—The Common Council on Oct. 26 passed the resolution authorizing the Board of Public Works to ask for bids for a garbage crematory, according to the plans of Rudolph Hering, Consult. Engr., of New York, N. Y.

BERKELEY, CAL.—All bids received on Oct. 6, by the city, for the destruction and disposition of all garbage, rubbish and waste matter have been rejected. New bids will be asked for a plant of 50 tons capacity.

STREETS AND ROADS.

(denotes that this work is advertised in Engineering News.)*

GREAT BARRINGTON, MASS.—J. F. McCORMICK, of East Providence, R. I., has been awarded the contract to construct 3½ miles of state highway, for which a state appropriation of $50,000 has been made.

HARTFORD, CONN.—Bids for the construction of state roads were received at the office of the State Highway Commissioner on Nov. 2, as follows: Town of Harwinton, 2,870 lin. ft. of grading and telford on the Thomaston Road, including one 15-in. tile culvert—Joseph Mascetti, Torrington, Conn., $4,290 for entire work; Pierson Engineering & Construction Co., Bristol, Conn., $4,500 for grading and 70 cts. per lin. ft. for telford; O. T. Benedict, Pittsfield. Mass., $7,000 and 60 cts.; F. J. Mague, West Newton, Mass., $6,850 and 50 cts.; Trumbull & Fabbri, Litchfield, Conn., $5,570 and 60 cts.; John de Michaels & Bro., Torrington, Conn., $4,676 and 70 cts.; Eveline Bros., Attleboro, Mass., $4916 and $1.25; A. D. Ambrosia & Bro., Hartford, $9,356 and $2.04; also 2,000 lin. ft. grading and railing, including one 12-in and one 18-in. tile culvert on Center Hill: Joseph Mascetti, $7,900 for grading and 19 cts. per lin. ft. for railing; Pierson Engineering & Construction Co., $10,500 and 30 cts.; O. T. Benedict, $9,100 and 40 cts.; F. J. Mague, $9,245 and 35 cts.; John de Michaels & Bro., $7,950 and 24 cts.; Eveline Bros., $10,200; A. D. Ambrosia & Bro., $9,750 and 38 cts. Town of Morris—2,700 lin. ft. gravel, including one 12-in. and one 18-in. tile culvert, on the Bantam Lake Road: Joseph Mascetti, Torrington, $4,590; Pierson Engineering & Construction Co., Bristol, $4,941; O. T. Benedict, Pittsfield, Mass., $4,833. Trumbull & Fabbri, Litchfield, Conn., $4,410. Town of Sharon, 3,325 lin. ft. gravel-telford on Amenia Road, including one 12-in., one 15-in., one 18-in. and one 24-in. tile culvert: Joseph Mascetti, Torrington, 94 cts. for gravel and $1.56 for telford; O. T. Benedict, Pittsfield, 90 cts. and $1.50; 4,540 lin. ft. gravel-telford on Millerton Road, including three 20-in., one 18-in., one 12-in. and one 15-in. tile culvert, Joseph Mascetti, $1.05 for gravel and $1.70 for telford; O. T. Benedict, 90 cts. and $1.50.

HARTFORD, CONN.—Contracts for the construction of state road work, bids for which were opened at the office of the State Highway Commissioner, on Nov. 7, have been awarded as follows:

Town of Naugatuck, 3,700 lin. ft., macadam on the Waterbury Road, including one 12-in. tile culvert, to O. T. BENEDICT, Pittsfield, Mass., at $1.75 per lin. ft. for macadam and $2.25 for telford. Other bidders were: Edward McManus, Waterbury, Conn., $2.10 and $2.90. T. H. Gill Co., Winter Hill, Boston, Mass., $1.99 and $2.60. Town of East Granby, 3,500 lin. ft. gravel telford on main road to Suffield, including one 15-in. tile culvert, to LANE CONSTRUCTION CORPORATION, Meriden, Conn., at $1.05 per lin. ft. for gravel and $1.65 for telford. The Board of Selectmen also submitted a bid of $1.08 for gravel and $1.90 for telford. Town of South Windsor, 13,890 lin. ft. macadam and telford, including bridge work and three 24-in., one 15-in., two 20-in., one 18-in., two 6-in. and two 12-in. tile culverts, to THOMAS KEARNEY, Meriden, Conn., at $1.47 per lin. ft. for macadam, $2.60 per lin. ft. for telford, 26 cts. per lin. ft. for railing and $1,450 for bridge work. Other bidders were: O. T. Benedict, $1.75, $2.35, 35 cts., and $3,000; Amos Bridge's Sons, Hazardville, Conn., $2.33, $3.75, 60 cts.; Pierson Engineering & Construction Co., Bristol, $2.73, $3.75, 40 cts.; A. C. Sternberg & Sons, West Hartford, $3.24, $3.94, 25 cts.; A. Brazos & Sons, Middletown, Conn., $2.98, $3.70.

The following contracts for state road work at Sharon, bids for which were opened on Nov. 2, have been awarded: O. T. BENEDICT, 4,540 lin. ft. gravel telford on Millerton Road, including three 20-in., one 18-in., one 12-in. and one 15-in. tile culverts, at 90 cts. for gravel and $1.50 for telford. Joseph Mascetti, Torrington bid 94 cts. and $1.56; 3,325 lin. ft. gravel telford on Amenia Turnpike, including one 12-in., one 15-in. one 18-in. and 24-in. tile culverts to same at 90 cts. for gravel and $1.50 for telford. Joseph Mascetti bid 94 cts. and $1.56; 1,825 lin. ft. grading on Duane Flat to same at 90 cts. and $1.50. Joseph Mascetti bid 94 cts. and $1.96.

All bids for the construction of 17,550 lin. ft. of macadam and telford, Town of Orange, were rejected owing to a technicality in bids. New bids will be asked.

BUFFALO, N. Y.—The Common Council has passed a resolution providing for repaving Vary St., 18 ft. wide. F. G. Ward is Comr. Pub. Wks.

BROOKLYN, N. Y.—Bids are asked by the Park Board, New York, until 3 p. m., Nov. 19, for regulating, grading and paving or repaving with asphalt pavement on a foundation of concrete the roadway of McLaughlin Park, between Bridge and Jay Sts., Borough of Brooklyn. Henry Smith is Pres. Bd.

BROOKLYN, N. Y.—Bids will be received until Nov. 17 by Bird S. Coler, Boro. Pres., for regulating and paving with asphalt on Etna, 80th, 49th and Ingraham Sts., Snediker Ave. and Harrison Pl., requiring in all 27,950 sq. yds. curbing and sidewalks on East Fourth, Fenimore, 55th, 45th, Henry and Winthrop Sts., Foster Ave., Farragut Road, Hickley Pl. and Prospect Pl., requiring in all 44,240 sq. ft. of cement sidewalks and 13,830 lin. ft. of new curb, etc.

BROOKLYN, N. Y.—Bids are asked by Bird S. Coler, Boro. Pres., until 11 a. m., Nov. 25, for regulating, repaving and paving with asphalt and granite on a concrete foundation the roadways of various streets; regulating, grading, curbing and laying crosswalks and sidewalks on various streets.

LONG ISLAND CITY (L. I.), N. Y.—Contracts for paving were awarded on Oct. 27 by Lawrence Gresser, Pres. Boro. of Queens, as follows: 18th Ave., to H. J. MULLEN, 289 Fulton St., Brooklyn, N. Y., $7,217; Vandeventer Ave., to TROSSI & CATALUZZI, $14,183.

NEW YORK, N. Y.—Bids are asked until noon, Nov. 19, by Allen N. Spooner, Comr. of Docks, for furnishing all the labor and materials required for repairing asphalt pavement on North and East Rivers, together with all work incidental thereto.

NEW YORK, N. Y.—Bids were received as follows on Nov. 2 by the Board of Trustees of Bellevue and Allied Hospitals for furnishing and setting w.-i. fence, granite fence posts and copings, sidewalks, curbs, sidewalk paving and other work in connection therewith in front of Pavillion A and the Pathological Department and Male Dormitory buildings of the New Bellevue Hospital, situated on First Ave. and bounded by 26th and 29th Sts., Borough of Manhattan: Thomas Cockerill, 147 Columbus Ave., $18,300; William Horne Co., 71 West 132d St., $19,700; Bart Dunn, 444 East 68th St., $18,000; Ficklin Concourse Construction Co., $21,245; J. M. Knopp, 270 West 19th St., $24,724; Kelly & Kelley, 45 East 42d St., $17,166; Joseph de Benedeth, $19,484; Guidone & Gelardi, 162 East 23d St., $18,377; McHarg-Barton Co., 165 Broadway, $21,830; Concourse Construction Co., $22,550; J. B. Malatesta, $18,999; H. E. Fox, 122 East 125th St., $23,500.

LONG ISLAND CITY (L. I.), N. Y.—Bids are asked until 11 a. m., Nov. 24 by Lawrence Gresser, Pres. Boro. of Queens, for regulating and repaving with granite block pavement on a sand foundation, paving with wood block pavement on a concrete foundation, paving with asphalt block pavement on a concrete foundation, regrading, curbing, recurbing and repaving with wood block pavement on a concrete foundation the roadways of various streets.

NEW BRIGHTON (S. I.), N. Y.—Bids are asked until noon, Nov. 24, by George Cromwell, Pres. Borough of Richmond, for furnishing all the labor and materials required for regulating and repaving with wood block pavement on a concrete foundation the roadway of Heberton Ave., from Post Ave. to Elizabeth St., together with all work incidental thereto.

YONKERS, N. Y.—Bids were received as follows on Nov. 2 by the Board of Contract and Supply for street grading:

Grading Sherwood Ave — McDONALD MURRAY, $15,400 (awarded contract); Fred. E. Gross, $15,649; Charlton & Weston, $15,737; Kelly & Hannifin, $15,940; O'Connor-McIntire Co., $16,953; M. J. Callahan, $17,725; Thomas Grady, $18,450; Fisher & Cozzo, $20,089. Grading Villa Ave—CHARLTON & WESTON, $6,057 (awarded contract); Fred. E. Gross, $6,178; McDonald & Murray, $6,300; F. A. Cianfaglione, $6,600; Kelly & Hannifin, $6,450; Fisher & Cozzo, $8,106; M. J. Callahan, $8,697. Grading Convent Ave—FRED. E. GROSS, $3,333 (awarded contract); McDonald & Murray, $3,500; James J. Corbalis, $3,681; Kelly & Hannifin, $3,865; Charlton & Weston, $3,945; Kearns & Hart, $4,100; F. A. Cianfaglione, $4,284; M. J. Callahan, $4,300. Grading Convent Ave—KEARNS & HART, $4,800 (awarded contract); McDonald & Murray, $4,800; Fred. E. Gross, $4,900; Charlton & Weston, $4,983; Kelly & Hannifin, $4,998; F. A. Cianfaglione, $5,580; M. J. Callahan, $6,390; James J. Corbalis, $5,690.

JERSEY CITY, N. J.—Bids are asked until 2 p. m., Nov. 15, by the Street and Water Board for the improvement of Cartaret Ave. George T. Bouton is Clk. Bd.

*CAPE MAY, N. J.—Bids were received as follows on Nov. 4 by the Board of Chosen Freeholders of Cape May County for the construction of a gravel road 2.094 miles long, known as Schellinger's Landing Road: William S. Shaw, Cape May City, $14,563; Sutton & Corson, Ocean City, N. J., $14,200; Robert E. Hand, Erma, $14,733; Edward Cresse, Cape May City, $12,997; J. L. Clymer, Marshall and Berks St., Philadelphia, Pa., $10,593. R. Fendall Smith is County Engr.

NORRISTOWN, PA.—Bids for paving with creosote block West Airy St. bridge were opened on Oct. 26 by the County Commissioners as follows: Kreodone Co., of Norfolk, Va., $12,400; Toledo-Massillon Co., Toledo, Ohio, $11,250.

SCOTTDALE, PA.—The contract for paving a portion of Arthur Ave. was awarded on Nov. 6 by the Borough Council to the HOMESTEAD SUPPLY CO., Homestead, Pa., at the following prices: 2,400 cu. yds. of excavation, 38 cts.; 3,200 lin. ft. of sand stone curbing, 53 cts.; 350 lin. ft. of backing stone at 40 cts.; 4,900 sq. yds. of paving with Fairmont wire cut brick at $1.29. Total, $9,069.

CLEARFIELD, PA.—Bids are asked until Nov. 20, by the State Highway Department, Harrisburg, Pa., for constructing 6,370 ft. of state road in Pike Township, Clearfield County.

UNIONTOWN, PA.—PATRICK RIDGE, Pittsburg, Pa., has secured the contract for constructing a state road in Dunbar Township, Fayette County.

YORK, PA.—Bids are asked until Nov. 20 by the State Highway Department, Harrisburg, Pa., for constructing 5,070 ft. of state road in Dillsburg Borough, York County.

BELLEFONTE, PA.—F. W. BOREMAN & CO., Inc., Lansdowne, Pa., have secured the contract for constructing a state road in Penn Township, Chester County.

COUDERSPORT, PA. — HAMMOND & SLOAN, 60 Wall St., New York, have been awarded the contract by the State Highway Department for constructing a state road in Eulalia Township, Potter County.

WAYNESBURG, PA.—The State Highway Department has awarded the contract to FREDERICK ROBINSON for the construction of the Oak Forest Road at about $75,756. The road will be three miles and 3,758 ft. long.

HAGERSTOWN, MD.—The Washington County Commissioners have rejected all bids for the construction of Charlton road, and decided to macadamize the road at cost of $3,000. Bids ranged from $20,000 to $25,000.

ORANGEBURG, S. C.—Bids will be received until Nov. 18 by J. W. H. Dukes, Mayor, and the City Council for grading, paving and draining West and East Russell St., requiring about 8,700 sq. yds. of pavement, and 1,500 lin. ft. of 10 to 20-in. drains with manholes, inlets, etc. Edward Hawes, Jr., is City Engr.

JACKSONVILLE, FLA.—Bids are asked until 2.30 p. m., Nov. 23, by the Board of Public Works for grading approximately 666 sq. yds., and for furnishing and placing in position approximately 600 lin. ft. of stone curbing, and for furnish[illegible] and for laying 666 sq. yds. [illegible] vitrified paving blocks [illegible] brand, with which to pave [illegible] 20 ft. wide, north from [illegible] distance of 300 ft. Phil[illegible] Engr.

PALATKA, FLA.—See i[illegible]

ANNISTON, ALA.—Bids until Nov. 12 by J. M. L[illegible] for constructing several [illegible] cement sidewalks. E. P. C[illegible]

MONTGOMERY, ALA.—A[illegible] of Montgomery have been [illegible] tract at about $6,000 for g[illegible] cling Coosada Ferry ro[illegible] Springs four miles toward [illegible] Bullen is County Engr.

NASHVILLE, TENN.—The [illegible] lic Works has awarded the [illegible] E. T. LEWIS CO. at 75 cts [illegible] repaving Cumberland River [illegible] vitrified brick. W. W. S[illegible] Engr.

JACKSON, MISS.—The ci[illegible] contract to the WEST CON[illegible] Chattanooga, Tenn., at $22,5[illegible] ing cement pavements and s[illegible] Royal St. Atwell Thompson [illegible]

TIFFIN, OHIO.—The Board [illegible] vice has awarded the contra[illegible] KING, Tiffin, for 4,175 sq. [illegible] paving on North Sandusky [illegible] John E. Diemer is Clk. Bd.

COLUMBUS, OHIO.—Bids w[illegible] by the County Commission[illegible] John Scott, Clk., until Nov. 2[illegible] ing material and repairing a [illegible] Fifth Ave., in Perry, Franklin [illegible] Townships.

CINCINNATI, OHIO.—Bids will be received until Nov. 27 by the Board of [illegible] missioners, Cincinnati, for re[illegible] field Pike in Springfield Township [illegible] ment of Ohio Pike in Anderson Township and other road work.

YOUNGSTOWN, OHIO.—The following are the low bids for paving High [illegible] Horan, $17,622; Kennedy Bros., $17,720; Mullin & Caldwell, $17,862.

EAST LIVERPOOL, OHIO.—Bids will be received by the Board of Public Service until noon, Nov. 23, for furnishing the necessary labor and materials for improving Pennsylvania Ave., from westerly end of Dry Run bridge to the westerly side of Mulberry St., by grading and paving with hard-burned vitrified fire brick and with all necessary curbs, sewers, gutters and drains.

OAKLEY (Cincinnati post-office), OHIO.—Bids are asked by Oscar Nosche, Village Clk., until noon, Nov. 19, for the construction of 4-ft. cement sidewalks on certain streets.

INDIANAPOLIS, IND.—The Commissioners of Marion County will soon ask for bids for the construction of three miles of brick road in Perry Township.

Commissioners of Marion County have let a contract to the HOLLORAN & HAVERSTICK CO., for the construction of the County line gravel road at $11,500.

INDIANAPOLIS, IND.—The UNION ASPHALT CONSTRUCTION CO., 505 Law Bldg., Indianapolis, has secured the contract for paving Hawthorne Lane with asphalt, at about $7,000.

INDIANAPOLIS, IND.—The Board of Public Works has decided to ask for bids for the following improvements: Graded roadway, cement walks and curb in Lasalle St.; asphalt roadway and brick gutters in Park Ave.; gravel roadway in Worman Ave.; cement walk and curbing in 31st St., and cement walks and curb in Park Ave., from 13th to 32d Sts. Blaine H. Miller is City Engr.

BELLEVILLE, ILL.—REEB BROS. have been awarded the contract at the following prices for paving Gold St.: For paving with Albion block, $1.89 per sq. yd.; 56 cts. for curbing; 50 cts. per ft. for sewer pipe, and $40 each for catch-basins.

SPRINGFIELD, ILL.—The Board of Local Improvements awarded the contract on Oct. 26 for paving a portion of Lincoln Ave. with asphalt to JOHN E. BRETZ at $1.80 per sq. yd. for paving and 53 cts. per ft. for curbing.

EAST ST. LOUIS, ILL.—We are officially advised that bids were received on Oct. 31 as follows by the Board of Local Improvements for furnishing material, grading, draining and paving with brick portions of 26th St., requiring 1,240 cu. yds. of earth fill in excess of excavation, 5,790 lin. ft. 5 x 20-in. sandstone curb, 10,882 sq. yds. of vitrified brick pavement, 240 lin. ft. 15-in. vitrified clay drain pipe: Keeley & Gaynord, $21,923; W. H. HILL, East St. Louis, Ill., $21,173 (awarded contract); Meyers Construction Co., $22,012; Walter Coonan, $22,613. Frank B. Hanna is Clk. Bd.

MAUSTON, WIS.—J. RASMUSSEN SONS CO., Oshkosh, Wis., has been awarded the contract for paving, curbing and guttering a portion of State St. K. L. Sharp is City Clk.

MUSKOGEE, OKLA.—Bids will be received until Nov. 16 for asphalt paving, approximately 300,000 sq. yds. L. B. Kinsey is City Engr.

LAWTON, OKLA.—CHARLES H. SHAW, of Muskogee, Okla., has secured the contract for paving D Ave., as follows: 26,400 sq. yds. paving, $1.85; 5,500 lin. ft. concrete gutter, 75 cts. John D. Kennard is City Engr.

BELLINGHAM, WASH.—RIDDLE, KAVANAUGH & HAWKINS have been awarded the contract for planking South Elk St. from Bryant to Adams Sts., by the Board of Public Works, at $5,271. Pierson & Webel bid $5,626 for this work.

VANCOUVER, WASH.—The Council has decided to pave First and Second sts., between Main and Washington Sts.

SALT LAKE CITY, UTAH.—Bids for curbing and guttering Extension No. 6 were opened on Oct. 23 by the Board of Public Works as follows: P. J. Moran, Salt Lake City, $17,724; James Kennedy, Salt Lake City, $21,786; Louis C. Kelsey is City Engr.

NAMPA, IDAHO.—The WARREN CONSTRUCTION Co. has been awarded the contract for paving a district No. 6 with bitulithic pavement at $128,996.

STE. EMILIE DE L'ENERGIE (Lecierceville post-office), QUE.—Bids will be asked until 4.30 p. m., Nov. 23, by Napoleon Tessier, Secy. Dept. Pub. Wks., Ottawa, Ont., for the construction of a roadway and the enlargement of block at Ste. Emile, Lotbiniere County.

MANUFACTURING PLANTS.

(denotes that this work is advertised in Engineering News.)*

BRIDGEPORT, CONN.—We are officially advised that the American & British Mfg. Co. has awarded contract for constructing a 1-story machine shop, 46 × 122 8 ft., to CASEY & HANLEY. The steel contract has been let to LEVERING & GARRIGUES; roof to NIGHTINGALE, CHILDS CO. Harry A. Slocomb, Providence, R. I., is Arch. The cost of the building is $7,000; cost of equipment has not been estimated.

NEW YORK, N. Y.—Bids are asked until 10 a. m., Nov. 25, by the Board of Health, Dr. Thomas Darlington, Pres., for furnishing all the labor and materials necessary or required to erect and complete a laundry building, together with all necessary alterations and other work incidental thereto, on the grounds of the Kingston Ave. Hospital at Kingston Ave. and Fenimore St., Boro. of Brooklyn.

ROCHESTER, N. Y.—L. Adler Bros. & Co., 92 St. Paul St., will erect a 4-story factory building, 202 × 275 ft., of reinforced concrete. Albert Kahn, 800 Trussed Concrete Bldg., Detroit, is preparing plans.

BINGHAMTON, N. Y.—C. Edward Vosbury, Arch., Binghamton Savings Bank Bldg., has let general contract to M. I. FORD for a 5-story cigar factory building, for Hummel & Co.

ELMIRA, N. Y.—Otis Dockstader, Arch., Robinson Bldg., Elmira, is completing plans for a 2-story and basement bakery building to cost $6,000.

GLEN COVE (L. I.), N. Y.—Contract will be let by Taylor & Mosley, 1 Nassau St., New York, for a 2-story laundry building at Glen Cove, for the Friends' Academy. See New York.

BUFFALO, N. Y.—The Barcals Mfg. Co. has had plans prepared for a 2-story brick addition to be built to its plant at Tecumseh and Kentucky Sts. Edward J. Barcals is Pres.

The Pullman Car Co. will add to its car building plant, Broadway and N. Y. C. & H. R. R. R., a 2-story brick storage building. Plans for same have been filed. H. E. Benson is Mgr., 1770 Broadway, Buffalo.

The contract for the erection of an ice cream factory for Charles Taylor, 237 Hampshire St., to be built in 15th St., Buffalo, is to be awarded at once. This is a brick structure, with concrete floors and foundations, three stories, 35 × 100 ft. It is expected that the building will cost $30,000. Louis P. J. Eckel, 191 York St., Buffalo, is Arch.

KEARNY, N. J.—Charles P. Baldwin, Arch., 15 Clinton St., Newark, is preparing plans for a 1-story linoleum mill for the Nairn Linoleum Co., Kearny.

NEWARK, N. J.—Four brick buildings will be erected at 543-555 Ferry St., by the Newark Tube & Metal Works. Each building will be 1 story high. The ground dimensions are, respectively, 100 × 190 ft., 34 × 92 ft., 26 × 20 ft., and 18 × 24 ft. All will be used for the manufacture of metal goods. The estimated cost for all is $18,000. The contract has been let to the RUSSELL-ROBINSON CO., 109 Frelinghuysen Ave., Newark, N. J.

J. Strombach, 238 Washington St., Newark, is drawing plans for a 1-story brick factory which Charles Becker & Co., 829 Broad St., will erect in Tenth St., near 15th Ave. The structure will be in two sections, one being 38 × 100 ft., the other 22 × 80 ft.

NEW SALEM, PA.—We are officially advised that the H. C. Frick Coke Co., Carnegie Bldg., Pittsburg, Pa., has awarded the contract for the piping and steam fittings and fixtures at the new Ralph and Sarah plants near New Salem to the W. M. KELLOGG CO., 50 Church St., New York.

OAKMONT, PA.—The Best Mfg. Co., 25th St., Pittsburg, and the Crane Co., of Chicago, Ill., have been consolidated under the name of the Crane-Best Co. of Pittsburg, and the new organization will build a plant on the site at Oakmont, Pa., recently purchased by the Crane Co. The plant will cost about $1,000,000, and contracts will be awarded soon, the plans having been prepared prior to the consolidation. When the new plant is completed, the local plant of the Best Mfg. Co. will be dismantled and abandoned, and the Crane-Best Company will act as the eastern branch of the Crane Company, which will continue to manufacture the same lines as at present at the big Chicago plant. Noted last week.

PHILADELPHIA, PA.—Charles W. Bolton & Son, Archs., Witherspoon Bldg., have let contract to BURD P. EVANS & CO., 706 North Ninth St., for boiler house and addition to laundry for the Pilgrim Laundry Co., Cost, $25,000.

It is stated that about $200,000 will be expended for an 8-story building, suitable for printing establishment which is to be erected at 235-37 South Third St., for Mershon Bros. Land Title Bldg. Plans have been completed by Milligan & Weber, Archs., 520 Walnut St.

WASHINGTON, D. C.—Bids are asked until 10 a. m., Nov. 12, by M. J. Rosenau, Dir. Hygienic Laboratory, 25th and E Sts, N. W., for furnishing the laboratory the following supplies: One lathe for power, one drill for power, one pipe machine for power, one 5-HP. motor.

CINCINNATI, OHIO.—A 3-story building for manufacturing purposes will be erected by the William Mayer Co., at 644 West Third St. Cost, $15,000.

CHICAGO, ILL.—The Western Steel Car & Foundry Co., Old Colony Bldg., has secured a site on the Calumet River retween 134th and 136th Sts., on which it is proposed erecting a foundry.

DUBUQUE, IOWA.—The Chicago, Milwaukee & St. Paul Ry. Co. will erect a car building plant at its shops here with a capacity of ten cars per day. D. J. Whittemore, Chicago, is Ch. Engr.

ST. PAUL, MINN.—OLAF SWANSON has secured the contract to construct a 2-story factory building for the Gribben Lumber Co. J. W. Stevens, New York Life Bldg., St. Paul, is Arch. Cost, $30,000.

ST. LOUIS, MO.—A 2-story carpenter shop to cost $30,000, will be erected, it is stated, by the Essmueller Mill Furnishing Co., 605 South Sixth St.

AMARILLO, TEX.—C. A. FELLOWS, of Los Angeles, Cal., has secured the contract to rebuild the shops and round-house here of the Atchison, Topeka & Santa Fe Ry., which was destroyed by fire Oct. 18. It is reported that the cost will be $100,000. W. P. Buck, Chicago, Ill., is Supt. of Motive Power.

HUBBARD CITY, TEX.—See item under Light and Power Plants.

MONTREAL QUE.—The CHARLES THACKERAY CO., 242 St. James St., Montreal, has been awarded the contract for the General Fire Extinguisher Co.'s proposed building. Robert Findlay, 260 St. James St., is Arch.

PORTO RICO.—Ice machinery and refrigerating machinery. See under U. S. Possessions and Cuba.

MISCELLANEOUS CONTRACTS.

(denotes that this work is advertised in Engineering News.)*

ICE-MAKING AND REFRIGERATING MACHINERY.—Porto Rico.—See under U. S. Possessions and Cuba.

VACUUM CLEANING.—Washington, D. C.—Bids are asked until Dec. 1 for installing vacuum cleaning system. See under Buildings.

*DREDGING.—Boston, Mass.—Bids are asked until noon, Dec. 9, by Lieut.-Col. Edw. Burr, Corps Engrs., U. S. A., for dredging in Essex River, Mass.

STEAMER.—Seattle, Wash.—The contract for repairing the steamer "Cottage City," of the Pacific Coast Steamship Co., was awarded to the MORAN CO., of Seattle, at $26,230.

EXCAVATION.—Tiffin, Ohio.—Bids will be received until Dec. 1 by C. J. Peters, County Engr., Tiffin, for work on Silver Creek, principally rock excavation. Estimated cost, $15,000.

STEAMER. — Collingwood, Ont. — The Northern Navigation Co. has awarded the contract to the COLLINGWOOD SHIPBUILDING CO. for a twin-screw steamer to cost $60,000.

*DREDGING.—Savannah, Ga.—Bids are asked until noon, Dec. 9, by Col. Dan C. Kingman, Corps Engrs., U. S. A., for dredging in waterway between Savannah, Ga., and Fernandina, Fla.

*PILE PIER.—Michigan City, Ind.—Bids will be received by Maj. Thos. H. Rees, U. S. A., Chicago, Ill., until noon, Dec. 12, for pile pier construction and removal of old pier in Michigan City Harbor, Ind.

EMBANKMENT.—Cleveland, Ohio.—Bids will be received until noon, Nov. 13, by the Board of Public Service for furnishing material and constructing an embankment on East 90th St. A. R. Callow, Secy.

DAM, ETC.—Ottawa, Ont.—Bids will be received by Nap. Tessier, Secy. Dept. of Public Works, Ottawa, until 4.30 p. m., Nov. 19, for the construction of a dam, bulkheads and slide at the Long Saulte Rapids, Ottawa.

PIPE FENCES.—New York, N. Y.—Bids are asked by the Department of Parks until 3 p. m., Nov. 19, for furnishing and erecting three-rail pipe fences along the east drive in Central Park, north from the 59th St. entrance, Boro. of Manhattan.

DRAINAGE.—Champaign, Ill.—Bids are asked by the Commissioners of Union District No. 1, towns of Ogden and Oakwood, until 9 a. m., Nov. 14, at office of Ray & Dobbins, Champaign, for drainage work in this district.

DRAINAGE.—Algona, Iowa.—Bids are asked until 2 p. m., Nov. 18, by A. L. Anderson, County Audr., for construction of drainage improvement known and designated as Drainage District No. 24, Kossuth County, Iowa.

GAS CYLINDERS.—Washington, D. C.—The following bids were opened Oct. 29 by the Chief Signal Officer, U. S. A., for furnishing 250 gas cylinders: Pressed Steel Tank Co., Milwaukee, Wis., $6,400; E. W. Bliss Co., Brooklyn, N. Y., $12,850.

LEVEE.—New Orleans, La.—The Orleans Levee Board has awarded contract to I. R. BOBBETT, Baton Rouge, La., for constructing the Upper Staunton levee on the Mississippi River at 24 2-5 cts. per cu. yd. Approximate quantity, 40,000 cu. yds.

CLEANING DITCH.—Kankakee, Ill.—Bids are asked by the Commissioners of the Minnie Creek Drainage District until 2 p. m., Nov. 16, for cleaning out the main ditch of this drainage district. Address Chas. B. Campbell, Trust Bldg., Kankakee.

LAWN-MOWERS, TOPSOIL, SHRUBS.—New York, N. Y.—Bids are asked by the Department of Parks until 3 p. m., Nov. 19, for furnishing and delivering in Prospect Park, Brooklyn, the following: Two gasoline lawn mowers, topsoil or garden mould, deciduous shrubs and plants, hybrid rhododendrons, collected evergreen shrubs, fertilizers, peat, etc.

LAUNCHWAY.—Atlantic City, N. Y.—Bids are asked by S. I. Kimball, Gen. Supt. U. S. Life-Saving Service, Washington, D. C., until 2 p. m., Nov. 20, for the construction of a lifeboat house and launchway at the Atlantic City, N. J., Life-Saving Station.

DITCH.—St. Joseph, Ill.—Bids are asked by the Commissioners of Union Drainage Ditch No. 2, Champaign County, Ill., until 9 a. m., Nov. 21, for work to be done on main open ditch in this district. C. H. Kienzle, Atty.

LENS.—Tompkinsville, N. Y.—Bids were received by the Light-House Engineer, Tompkinsville, on Oct. 21, on second order bivalve lens for the Dry Tortugas (Fla.) light station. Contract was awarded to Estate of HENRY LAPAUTE, Paris, France, at $7,500.

WHARF, ETC.—St. Joseph, Mich.—Bids were opened on Oct. 14 by the Light-House Engineer for the construction of a new revetment and wharf at the St. Joseph lighthouse depot. Contract was let to the COLUMBIAN CONSTRUCTION CO., Muskegon, Mich., at $13,463.

*CHANNEL.—Chicago, Ill.—The Sanitary District of Chicago, American Trust Bldg., announces to contractors that the date for receiving bids for the work advertised as Section 12 of the North Shore Channel has been postponed until noon, Nov. 18. I. J. Bryan, Clerk.

CONDUIT.—Canajoharie, N. Y.—Bids will be received Nov. 23 for the construction of a vitrified mutiple duct conduit in Church St., Canajoharie. The work consists of about 900 ft. of conduit with the necessary laterals and appurtenances. Chas. E. Perry, Canajoharie, is Engr.

*WHARF.—Washington, D. C.—Bids are asked by the Light-House Engineer, Baltimore, until noon, Nov. 27, for furnishing materials and labor of all kinds necessary for the construction of a light-house depot wharf at the intersection of O and Water Sts., Washington, D. C.

REMOVING WRECK.—Wilmington, Del.—Bids were received on Nov. 3 by Capt. L. H. Rand, Corps Engrs., U. S. A., for removing wreck of steamer "Gulf Stream," lying sunk at entrance of Hereford Inlet, N. J. Contract awarded to EUGENE BOEHM, Atlantic City, N. J., at $1,512.

*DREDGING.—Tuckerton, N. J.—Bids were received as follows on Oct. 30 by Capt. L. H. Rand, Corps Engrs., U. S. A., Wilmington, Del., for dredging Tuckerton, Creek, N. J.; River & Harbor Improvement Co., Philadelphia, 33 cts. per cu. yd.; Rickards Dredging Co., Philadelphia, 28 cts.

CEMENT.—New York, N. Y.—Bids are asked until noon, Nov. 19, by Allen N. Spooner, Comr. Docks, (Contract No. 1152): For furnishing all the labor and materials required for furnishing and delivering cement: Class 1-A, 5,000 barrels of cement; Class 1-B, 20,000 bags of cement.

LEVEES.—Bryan, Tex.—Bids will be called for about Jan. 1 by the Commissioners of Drainage Dist. No. 1, Brazos County, for constructing levees 18 miles southwest of Bryan. T. R. Batte, Jr., Bryan, is Engr.-in-Charge. Estimated quantity of earth material, 450,000 cu. yds. Estimated cost, $65,000.

DITCH.—Glenwood, Iowa.—Bids were received on Nov. 2 by B. T. Agan, County Audr., Glenwood, for constructing Pony Creek Ditch and levees in Pony Creek Drainage Ditch No. 1, consisting of 125,158 cu. yds. Contract was awarded to LAMOREAUX & PETERSON, Omaha, Neb., at 14½ cts. per cu. yd.

LUMBER.—Jeffersonville, Ind.—Bids are asked until Nov. 17 by the Depot Quarter Master, Jeffersonville, Ind., under abstract 398, for furnishing 100,000 ft. of lumber. It is estimated that there will be required one carload of white pine, two carloads of yellow pine, two carloads of cottonwood and two carloads of red gum.

*CONCRETE WHARF.—Detroit, Mich.—Bids were received by the Public Lighting Commission on Nov. 2 for constructing a concrete wharf in rear of power house. F. Mistersky, Gen. Supt., 40 Atwater St., East Detroit. Contract was awarded to the GREAT LAKES DREDGE & DOCK CO., Cleveland, Ohio, at $9,000.

DRAIN.—Stonington, Ill.—Bids will be received until Nov. 16 by the Drainage Commissioners of District No. 4, town of Stonington, A. B. Chapman, Chn., for furnishing trenching, laying, etc., vitrified glazed tile. Total, about 54,025 ft. of 7-in. to 28-in. tile. J. W. Dappert, Engr., Taylorville, Ill. Tony W. Hooper, Town Clk.

DRAINAGE CANAL AND LEVEE.—Clarksdale, Miss.—Contract for developing a drainage district in the delta of the Mississippi was awarded on Oct. 24 to R. H. McWILLIAMS, Mattoon, Ill., at 14¼ cts. per cu. yd. J. M. Oliphant, Clarksdale, Miss., is Supervising Engr. for the Yazoo-Mississippi Delta Levee District. Estimated quantity, 1,000,000 cu. yds. dredging.

*DRAINAGE.—Cerro Gordo, Ill.—Bids were received by the Commissioners of Union Drainage District No. 3, Cerro Gordo and Willow Branch Townships, Piatt County, Ill., on Oct. 30, for furnishing, hauling, laying and back filling various quantities of various size vitrified red clay or shale tile. Contract was awarded to H. S. WALTER, Cisco, Ill., at $9,245, complete. J. C. Locher, Town Clk.

FENCE, ETC.—New York, N. Y.—Bids are asked by the Bellevue and Allied Hospitals Department until 3 p. m., Nov. 20, for furnishing and setting wrought iron fence, granite fence posts and copings, sidewalk curbs, sidewalk paving and other work in connection therewith in front of Pavilion A and the Pathological Department and Male Dormitory buildings of the New Bellevue Hospital, situated on First Ave. and bounded by 26th and 29th Sts.

TELEPHONE LINE.—Ancaster, Ont.—The County Council has granted a franchise to F. Reinke and C. Shaver to install a telephone line between Ancaster and Waterdown, a distance of about 21 miles. The cost of the system is estimated at about $10,000.

CAUSEWAY.—Galveston, Tex.—At a recent conference held in the office of Judge J. W. Terry, Gen. Counsel for the Atchison, Topeka & Santa Fe Ry., and representing all the railroad interests, the County Commissioners agreed to all the details of the proposed causeway contract. It will cost about $1,400,000, of which the county is to pay one-fourth, the Galveston-Houston Electric Interurban Ry. one-fourth and the steam railroad companies one-half.

DREDGING.—New York, N. Y.—Bids are asked until noon, Nov. 20, by Allen N. Spooner, Comr. Docks, for the following work: Contract No. 1141. For furnishing all the labor and materials required for dredging about 25,000 cu. yds. of material in the Boroughs of Manhattan, Brooklyn, Queens, the Bronx and Richmond. And Contract No. 1154: For furnishing all the labor and materials required for dredging about 200,000 cu. yds. on the North River.

CANAL.—Chicago, Ill.—At recent election the citizens of Illinois voted to issue bonds for $20,000,000 to construct a channel from Lockport to Utica on the Illinois River. As little opposition by the Legislature is expected to the passage of a deep waterway law, it is stated that by 1915 Illinois will have a 14-ft. channel from Chicago to the Mississippi River. "We have positive assurance from Washington," R. I. Randolph, Secy. of the Internal Improvement Commission, has stated, "that if this Illinois waterway is constructed, the federal government will see that the remainder of the work outside of Illinois is done."

LEVEE.—New Orleans, La.—Bids were received on Oct. 26 by the Board of State Engineers for levee work. The contract for building the Scarsdale levee, in Plaquemines Parish, to contain 20,000 cu. yds. of earth, was awarded to NAT. G. SCOTT, at 24¾ cts. per cu. yd. Bids were opened for the construction and enlargement of six levees in the Atchafalya Basin Levee District. All bids for the enlargement of Halloway and Latenache levee were rejected on account of the price being too high and it was decided not to do the work this season. Bids for the construction of Lake Bayeu leve were found too high and this work will be advertised again. Awards were made for the construction of Milam, Fleta and Souvenir levees as follows: For the construction of Milam levee on the Atchafalaya River, in Point Coupee Parish, 25,000 cu. yds., the bid of R. T. CLARKE was accepted at 17.90 cts. For the construction of Fleta Levee on the Mississippi River, in Point Coupee Parish, 105,000 cu. yds., the bids of LUMAN BROS., 21.49 cts. per cu. yd. was accepted. For the construction of Souvenir levee on the Mississippi River, in Ascension Parish, 160,000 cu. yds., the contract was awarded to CLARK & GIBSON, at 18.72 cts. Contract for the construction of the Belle Helene levee in Ascension Parish, to contain 25,000 cu. yds, was let to R. T. CLARKE, at 18 cts.

SUBMARINES.—Washington, D. C.—Bids were received as follows on Nov. 2 at the office of the Secretary of the Navy, Washington, D. C., for furnishing submarine torpedo boats. Bids were received from the Electric Boat Co., 11 Pine St., New York, the Lake Torpedo Boat Co., of Bridgeport, Conn., and the American Laurenti Co., Philadelphia.

Electric Boat Co.'s boats are to be built at Quincy, Mass., by the Fore River Shipbuilding Co. and the Electric Boat Co. For boats, 400 to 425 tons displacement, Model 20-D, one $433,000; two, $428,000; three $420,000; four or more, $418,000. Model 20-C, one $429,000; two, $424,000; three, $416,000; four or more, $414,000. Model 20-B, one, $444,000; two, $439,000; three, $431,000; four or more, $429,000. Model 20-A, same price. Boats 340 to 375 tons: Model 19-A, one, $390,000; two, $380,000; three, $377,000; four or more, $375,000. Model 18-C, same prices. Model 18-B, one, $380,000; two $370,000; three, $367,000; four or more, $365,000. Model 18-A, one, $375,000; two, $365,000; three, $362,000; four or more, $360,000. For boats to be built either at the Union Iron Works, San Francisco, or Moran Bros., Seattle: Model 20-D, four or more, $450,000 each. Model 20-C, $446,000. Models 20-B and 20-A, $461,000. Models 19-A and 18-C, $403,000. Model 18-B, $393,000. Model 18-A, $388,000.

Lake Torpedo Boat Co.'s boats are to be built at Bath, Me., 518 tons, one $460,000; two, $450,000; three, $442,000; four or more, $435,000. 410 tons, one, $410,000; two, $400,000; three, $385,000; four or more, $382,000. To be built on Pacific Coast: 518 tons, one, $500,000; two $490,000; three, $485,000; four or more, $382,500. 410 tons, one, $435,000; two, $430,000; three ore more $425,000.

American Laurenti Co.'s boats are to be built at Cramp's Ship-yards, Philadelphia: 532 tons, one, $437,500; two, $437,500.

BATTLESHIPS.—Washington, D. C.—Bids were received Nov. 9 at the office of the Secretary of the Navy, Washington, for the construction of the new battleship 31, to be called the "Utah." The vessel is to have a speed of 20¾ knots and the Navy Department is asking for bids on the hull and machinery according to the Department's specifications, using (a) turbine engines and (b) reciprocating engines, and also (c) for hull on Department's specifications and machinery on bidder's specifications: William Cramp & Sons, Shipbuilding & Engine Co., Philadelphia, (a) $4,330,000; (b) $4,270,000; 35 months; (c) 21 knots, with Cramp machinery, 36 months, $4,450,000. Newport News Shipbuilding and Dry Dock Co., Newport News, Va., (a) $4,180,000; (b) $4,-

150,000; (c) Parsons engines, $4,100,000; reciprocating engines, $4,070,000. New York Shipbuilding Co., Camden, N. J., (a) $3,946,000. Fore River Shipbuilding Co., Quincy, Mass., (c) Curtis turbine engines, 20¾ knots, $4,463,000, $4,472,000, $4,393,000, $4,413,000; 21 knots, $4,510,000 $4,519,000, $4,440,000, $4,460,000. All bids for construction in 32 months unless specified.

Bids were also received on the machinery for the new battleship 30, the "Florida," which is to be constructed at the Navy Yard, New York: Newport News Shipbuilding & Dry Dock Co., Newport News, Va., on department's specifications, $1,715,000; on Parsons turbine engines, $1,517,000; on reciprocating engines, $1,588,000; same with Mosier boilers, $1,542,000; 20¾ knots. The Fore River Shipbuilding Co., submitted a bid on certain parts of the equipment, but could not figure on the entire order.

Bids were also received for the armorplate equipment for battleships 30 and 31, in the following quantities, Class A, 8,487 tons or less; Class B, 467 tons or less; Class C, 390 tons or less; Class D, 74 tons or less: Midvale Steel Co., (A) $420 per ton; (B) $405; (C) $462; (D) $512. Carnegie Steel Co., (A) $420; (B) $415; (C) $455; (D) $490. Bethlehem Steel Co., (A) $420; (B) $408; (C) $470; (D) $508.

HOSE.—Washington, D. C.—Bids were received as follows by the District Commissioners on Nov. 4 for furnishing the fire department with 15,000 ft., more or less, of cotton, rubber-lined, and rubber fire hose, 2½-in. inside diameter for the ensuing year: Gutta Percha & Rubber Mfg. Co., New York, Maltese Cross Brand, $1.10 per ft.; Baker, $1; Fidelity, 90 cts. Eureka Fire Hose Co., New York, Paragon, $1; Monitor, 80 cts. Diamond Rubber Co., New York, Diamond Brand, $1.05. B. F. Goodrich & Co., Akron, Ohio, rubber hose, $1; cotton, rubber lined, 67 cts. Fabric Fire Hose Co., New York, Keystone, $1; Deluge, 80 cts.

HOSE, BOILERS, WIRE.—Buffalo, N. Y.—The Fire Commissioners have awarded the following contracts: To the EUREKA FIRE HOSE CO., contract for circular, solid woven, rubber lined hose, at bid as follows: 5,000 ft., more or less, 2½-in. Eureka Brand hose, at $1.10 per ft.; 1,000 ft., more or less, 3½-in. Eureka Brand hose, at $1.50 per ft. To the AMERICAN-LAFRANCE FIRE ENGINE CO., for rebuilding and attaching new boilers on engines Nos. 11 and 26, at its bid of $4,000 for the two engines. To McCARTHY BROS. & FORD for copper line telegraph wire at their bid as follows: 34 miles No. 10. B. & S. G. hard drawn bare copper line wire, at $15.425 per 100 lbs.; 26 miles No. 10 B. & S. G. hard drawn triple braid weather-proof copper line wire, at $16.30 per 100 lbs.

LEVEE.—Vicksburg, Miss.—Bids were received as follows on Nov. 3 by Capt. Clarke S. Smith, Corps Engrs., for (A) about 123,000 cu. yds. of levee work on Red River in Bossier Parish, La., and (B) for 80,000 cu. yds. in Lower Yazoo, District, Miss., on Mississippi River: (A) Roach and Stansell, Memphis, Tenn., 17 cts. per cu. yd.; Israel R. Bobbitt, Baton Rouge, La., 14.4 cts.; W. H. North, Dixie, La., 14.15 cts.; M. Tansey, Winnfield, La., 13 cts.; O. E. Gammill, Shreveport, La., 10.89 cts.; W. R. Cavett, Shreveport, 14.½ cts.; George Epple, Shreveport, 19.64 cts.; R. L. Leonard, Memphis, 15 cts.; Telgason Bros., Vicksburg, Miss., 12.45 cts.; Thomas Worthington, Shreveport., 14.47 cts.; Hall Nattin, Shreveport, 14.47 cts.; McDade Bros. & Wimbish & Hunt, McDade, La., 13.75 cts.

(B) Lacy Bros., Arkansas City, Ark., 33 cts.; Roach & Stansell, Memphis, 32 cts.; Dulaney & Foote, Grace, Miss., 28.70 cts.; Shields Bros. & Nystrom, Greenville, Miss., 25.25 cts.; Helgason Bros., Vicksburg, Miss., 28.75 cts.; R. L. Leonard, Memphis, 33 cts.

METAL LOCKERS.—Washington, D. C.—Bids were received as follows by Maj. M. Gray Zalinski, Depot Q. M., U. S. A., on Nov. 7, for furnishing f. o. b. at the place of manufacture about 5,000 standard metal wall lockers: Bids were asked for (a) single; (b) double; (c) triple, and (d) quadruple lockers: W. B. Moses & Sons, Washington, (a) $16.55; (b) $15.99; (c) $15.82; (d) $15.79. Van Dorn Iron & Mfg. Co., Cleveland, Ohio, (a) $11.70; (b) $10.63; (c) $10.29; (d) $10.26. Canton Art Metal Construction Co., Canton, Ohio, (a) $9.47; (b) $8.42; (c) $7.87; (d) $7.62. Edward Darby & Son, Inc., Philadelphia, (a) $23.60; (b) $21.20; (d) $20; (c) $20.40. Merritt & Co., Camden, N. J., (a) $12.12; (b) $11.37; (c) $11.12; (d) $10.99. On bidder's samples, (a) $8.32; (b) $7.47; (c) $7.23; (d) $7.12. Hess Warming & Ventilating Co., Chicago, (a) $8.80; (b) $8.16; (c) $7.93; (d) $7.79. Durand Co., Chicago, on bidder's sample, (a) $9.44; (b) $8.375; (c) $8.033; (d) $7.98. Steel Fixture Mfg. Co., Topeka, Kan., (a) $10.92; (b) $10.26; (c) $10.42; (d) $10.17; alternate (a) $11.37; (b) $10.86; (c) $10.64; (d) $10.60. Art Metal Construction Co., Jamestown, N. Y., (a) $10.90; (b) $10.90; (c) $10.90; (d) $10.80. General Fireproofing Co., Washington, (a) $12.90; (b) $11.25; (c) $10.15; (d) $9.25.

U. S. POSSESSIONS AND CUBA.

PILING.—Panama.—The Isthmian Canal Commission has awarded contract for furnishing 2,076 untreated piles to D. L. GILLESPIE & CO., Pittsburg, at $19,708.

LUMBER.—Panama.—Bids are asked until 2 p. m., Nov. 18, by Maj. Wendell L. Simpson, Commissary Purchasing Agt., Panama R. R. Co., 24 State St., New York, for furnishing lumber.

DUMP CARS.—Panama.—The Isthmian Canal Commission has awarded contract for the purchase of 200 dump cars, to the WESTERN WHEELED SCRAPER CO., Aurora, Ill., at $948 each.

BRIDGE TIES.—Panama.—The Isthmian Canal Commission has awarded contract for furnishing 8,000 creosoted bridge ties to the GULFPORT CREOSOTING CO., Gulfport, Miss., at $14,450.

DUMP CARS.—Panama—Bids are asked until Nov. 27 by Capt. F. C. Boggs, Corps Engrs., U. S. A., General Purchasing Officer, Isthmian Canal Comn., Washington, D. C., for furnishing four steel dump cars, Circular 477.

BOILER PLANT.—Panama.—The Isthmian Canal Commission has awarded contract for the erection and equipment of two boiler plants to the D'OLIER ENGINEERING CO., 121 South Eleventh St., Philadelphia, at $113,240.

RAPID UNLOADING CRANES.—Panama.—Bids are asked until 10:30 a. m., Nov. 24, by Capt. F. C. Boggs, Corps Engrs., U. S. A., Gen. Purchasing Officer, Isthmian Canal Comn., Washington, D. C., for three rapid unloading cranes.

ICE-MAKING AND REFRIGERATING MACHINERY.—Porto Rico.—Bids are asked until 11 a. m., Nov. 21, by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for furnishing and installing ice-making and refrigerating machinery at Navy Station, Culebra, Porto Rico. Specifications are on file at office of Engineering News, New York.

LOCOMOTIVES.—Panama.—Bids were opened at the office of the Panama R. R. Co., 24 State St., New York, on Oct. 28, for furnishing twelve locomotives; delivery, Colon, as follows: AMERICAN LOCOMOTIVE CO., New York, $11,950 each; Mogul type, freight, oil burning; delivery 70 days (awarded contract). Burnham-Williams Co., Philadelphia, Pa., $12,574 each; delivery, 120 days.

ENGINEERING SUPPLIES.—Panama.—Bids were received as follows Nov. 2, at the office of the Isthmian Canal Commission, Washington, for engineering supplies under Circular 473. Class 1, a large quantity of sheet steel, Class 10, 108,000 ft. pipe, black, wrought iron or steel; Class 11, 337,000 ft. galvanized pipe, wrought iron or steel; Class 12, 71,000 ft. extra-strong wrought-iron pipe: Central Metal & Supply Co., Baltimore, (1) $33,708, part; (10) $4,900, part; (11) $16,369, part; (1) $4,150, part. Drummond, McCall & Co., Baltimore, (1) $36,394. J. B. Kendall, Washington, (1) $35,096. U. S. Steel Products Export Co., New York, (1) $35,-188; (10) $12,614; (11) $45,855; (12) $38,-871. Griscom Spencer Co., 90 West St., New York, (10) $15,626, $14,312; (11) $54,613, $52,047; (12) $54,726, $48,247. Mark Mfg. Co., Chicago, (10) $14,002; (11) $51,700; (12) $43,676. Pancoast, Rogers & Richards, 28 Platt St., New York, (10) $17,637; (11) $57,-610; (12) $45,735. Youngstown Sheet & Tube Co., Youngstown, Ohio, (10) $16,444; (11) $54,927; (12) $43,529. Cornell & Underhill, 43 Beach St., New York, (12) $42,518.

CRANES.—Panama.—Bids were received as follows on Nov. 5 by the Isthmian Canal Commission, Washington, for furnishing four chamber and four berm cranes, electrically operated, for use at Pedro Miguel and Miraflores in connection with the construction of the locks. The original bid consists of Item 1, four berm cranes, Item 2, four chamber cranes, and include in their equipment, hoisting and trolley motors, traction motors, motors for driving cement conveyors, cement conveyors, motors for driving concrete mixers and self-filling automatic grab buckets. Alternate A contemplates two receiving hoppers, 10 cu. yds. capacity, on the berm crane side of each chamber crane. Alternate B contemplates the use of travelers and derricks as a substitute for chamber cranes, and Item 3 shows the price of the traveler and derricks, independent of the original bid: American Hoist & Derrick Co., St. Paul, Alternate B, Item 3, $90,170; shipment, 180 days. Brown Hoisting Machinery Co., Cleveland, Ohio, Item 1, $377,100; Item 2, $195,-300; total, $572,000; Alternate A, add $24,-600 to total; Alt. B, add $53,900; Item 3, $249,200; 305 days. Christiana Machine Co., Christiana, Pa., three semi-balanced cable cranes, double enders, forming six cableways, on bidder's specifications, $226,648; Alternate on bidder's specifications, $200,-313; 240 days. Cleveland Crane & Engineering Co., Wickliffe, Ohio, Item 1, $219,114; Item 2, $120,720; total, $339,836; Alt. A, add $20,000; Alt. B, deduct $17,000; Item 3, $127,020; time, 350 days. Conveying Machinery Co., 120 Liberty St., New York, $2,750; $2,450 for buckets only. J. M. Dodge Co., Nicetown, Pa., Item 1, $215,240; Item 2, $90,226; total, $314,536 without feeders; Alt. A, add $9,436; Alt. B, add $42,728; Alt. B1, $32,800; Alt. C, add $5,556; D, add $9,028; E, add $16,720; F, add $6,700; G, add $11,560; K, add $22,188; L, add $30,-364; M add $26,132; N, add $9,552. Modern Steel Structural Co., Waukesha, Wis., Item 1, $266,984; Item 2, $94,796; total, $361,780; Alt. A, add $5,772; Alt. B, add $33,316; Item 3, $129,112; time, 285 days. Morgan Engineering Co., Alliance, Ohio, Item 1, $332,700; Item 2, $140,900; total, $473,600; Alt. A, add $19,300; Alt. B, add $4,500; Item 3, $145,400; time, 300 days. Shaw Electric Crane Co., Muskegon, Mich., Item 1, $248,302; Item 2, $158,340; total, $406,842; Alt. A, add $5,400; Alt. B, add $111,394; Item 3, $269,734; time, 300 days. Wellman-Seavor-Morgan Co., Cleveland, Ohio, Item 1, $196,008; Item 2, $90,-384; total, $286,392; Alt. A, add $8,216; Alt. B, add $12,992; Item 3, $108,488; Alt. C, deduct $5,556.

CIVIL SERVICE EXAMINATIONS.

DRAFTSMEN.—Albany, N. Y.—The State Civil Service Commission will hold examinations on Nov. 21 for the following positions: Architectural Draftsman, State Architect's Office, $15 to $25 a week; Engineering Draftsman, Public Service Commission, First District, $1,200 to $1,800. The last day for filing applications for these positions is Nov. 14th.

INDUSTRIAL NOTES.

THE EXPANDED METAL & CORRUGATED BAR CO., St. Louis, Mo., has recently inaugurated the practice of selling fabricated reinforcement—that is, the complete reinforcement required for any structure, bars and stirrups bent, ready to place in the forms. This method of purchasing reinforcing steel has many advantages—the engineer or architect is assured of accurate work and the contractor is relieved of all bending on the job.

THE PENN BRIDGE CO., Beaver Falls, Pa., has recently received contracts for steel lock gates for the U. S. Government at Hales Bar, Tenn., aggregating 240 tons; also for the steel work for foundry building for the Standard Sanitary Mfg. Company, at New Brighton, Pa., requiring 560 tons of steel. The five bridges for which contract has been awarded to the company by the Department of Public Works, New York States, will require 250 tons and bridges recently contracted for in North Carolina 200 tons additional.

THE ANNUAL MEETING of the stockholders of the Rail Joint Company was held at the office of the company, Troy, N. Y., Oct. 28, and directors were chosen as follows: Geo. G. Frelinghuysen, Frederick T. Fearey, E. Y. Weber, C. P. Wheeler, Mark T. Cox, Marcus L. Ward, F. C. Runyon, L. F. Braine, Percy Holbrook, Benjamin Y. Wolhaupter and Geo. A. Weber. The directors subsequently organized with these officers: Chairman of the board, Geo. G. Frelinghuysen; President, Frederick T. Fearey; Vice-Presidents, L. F. Braine and Percy Holbrook; Secretary, Benjamin Y. Wolhaupter; Treasurer, F. C. Runyon.

AMERICAN COMPRESSOR & PUMP CO., 26 Cortlandt St., New York, has been organized for the manufacture of air and gas compressors, air receivers, high duty vacuum pumps, pneumatic specialties, etc. The works, located at 718 East Pratt St., Baltimore, Md., are in charge of Alexander Slaysman, Jr., of the firm of Slaysman & Co., engineers, machinists and manufacturers of automatic can making machinery, etc. The sales department is in charge of Frederick B. Vail, who has recently severed his connection as general sales agent of the American Air Compressor Works. Mr. Vail has been connected with these parties since their organization, and previous to this was manager of the Clayton Air Compressor Works.

THE STONE & WEBSTER ENGINEERING CORPORATION, Broad and Milk Sts., Boston, embodies the former engineering construction and purchasing departments of Stone & Webster. The corporation designs and builds railways, water powers, lighting and power plants, high tension transmission and distributing systems and reinforced-concrete and steel-frame buildings. The power plants built in recent years with those now under construction aggregate about 250,000 HP. They are widely distributed from Maine to Puget Sound and from the Great Lakes to the Gulf. The electric railways constructed include several hundred miles of both third rail and overhead systems in various parts of the country. The staff has also engaged in the erection of modern office buildings and industrial plants.

E. KEELER CO., Williamsport, Pa., has recently been awarded a large contract consisting of twelve 410-HP. Keeler water tube boilers, by the Isthmian Canal Commission. These boilers will be used in two plants, one of these being situated at Gatun, and the other at Miraflores, on the line of the Panama Canal. They will be used to operate the cableways and other machinery for building the locks and dams at the above points. These points are situated about nine miles from either end of the canal. Gatun being on the Atlantic and Miraflores at the Pacific side of the Isthmus. This is said to be the largest boiler order placed by the government for the Panama Canal work, and the first permanent plant to be installed on the Isthmus. The boilers will be used in the permanent operation of the canal after the construction is finished. The general contract for this work was taken by the D'Olier Engineering Co., of Philadelphia, Pa., and includes the well-known Foster superheaters, manufactured by the Power Specialty Co., and Ajax shaking grates, manufactured by the Valley Iron Works, Williamsport, Pa.

For other Proposal Advertisements see pages 43, 44, 45, 46, 49, of Advertisements and Construction News page 172.

CAST-IRON PIPE AND SPECIAL CASTINGS.

NOTICE TO CONTRACTORS.

Amsterdam, N. Y.

Sealed proposals for furnishing cast-iron water pipe and special castings will be received by the Board of Water Commissioners of the City of Amsterdam, N. Y., at their office in the Farmers' Bank Building, until 8 o'clock p. m. of November 24th, 1908, at which hour said proposals shall be opened and read in the presence of said Water Commissioners.

All proposals shall be enclosed in a sealed envelope addressed to Charles C. Yund, President of the Board of Water Commissioners, Amsterdam, N. Y., and across the end of such envelope and upon the face side of same, the words "Proposal for Cast-Iron Pipe for Hanns Creek Conduit No. 2" shall be written.

Each proposal shall contain a certified check or a New York or Amsterdam draft in the amount of $10,000 (ten thousand dollars) payable to the order of John J. Turner, the Treasurer of Water Commissioners, Amsterdam, as a guarantee that the bidder will enter into contract in case of award to him, or in case of his failure so to do, said amount shall be absolutely forfeited to said water commissioners.

No checks or drafts to be presented to the Board of Water Commissioners, shall be returned to the bidder after the award and signing of the contract and the furnishing of satisfactory sureties and bond for faithful performance by the successful proposer. No bids to be withdrawn after they have been opened by the Water Commissioners.

The Board of Water Commissioners expressly reserves the right to reject any or all proposals if such action shall seem to them to be for the best interests of the city. Specifications and proposal blanks for this contract may be procured by intending bidders, by application to James R. Snell, Superintendent of the Water Works, after November 12th, 1908.

Approximate Quantities.

The approximate quantities of pipe and castings are as follows:

30 inch straight piping	3,528
24 inch straight piping	3,844
Smaller sizes, straight piping	16½
30 inch special castings	25
24 inch special castings	20
30 inch inspection castings	16
24 inch inspection castings	20

CHARLES C. YUND,
President of the Board of Water Commissioners, Amsterdam, N. Y.

FRANK H. M'CONNELL,
Secretary of the Board of Water Commissioners, Amsterdam, N. Y.

MACADAM ROADS.

Hillsdale, N. J.

Sealed proposals will be received by the Township Committee of the Township of Hillsdale, at the Town Hall, Hillsdale, N. J., at 8.30 P. M., Nov. 28, 1908, for macadamizing and grading Yesler Way, Piermont Ave., Fairview Ave., Lawrence St. and Magnolia Ave.; Magnolia Ave. and Washington Ave., and Summit Ave., a total distance of 2.656 miles.

Plans and specifications can be seen at the office of the State Commissioner of Public Roads, State House, Trenton, N. J., or at the office of N. G. Hering, Jr., Township Engineer, Hillsdale, N. J.

Each bid must be accompanied with a certified check in the sum of $1,000 as a guarantee of good faith.

The Township Committee reserve the right to reject any or all bids.

ALBERT MOHURKING,
Chairman of Township Committee.
WILLIAM W. BANTA,
Township Clerk.

Dated Nov. 9, 1908.

MACADAM ROADS.

Hillsdale, N. J.

Sealed proposals will be received by the Township Committee of the Township of Hillsdale, at the Town Hall, Hillsdale, N. J., at 8 P. M., Nov. 28, 1908, for macadamizing and grading about 5.33 miles of streets in the Township of Hillsdale.

Plans and specifications can be seen at the office of H. G. Hering, Jr., Township Engineer, Hillsdale, N. J.

Each bids must be accompanied by a certified check, in the sum of $1,500 as a guarantee of good faith.

The Township Committee reserve the right to reject any or all bids.

ALBERT MOHURKING,
Chairman of Township Committee.
WILLIAM W. BANTA,
Township Clerk.

Dated Nov. 9, 1908.

FOR SALE

FOR SALE.

1 FRAZER & CHALMERS

Cross Compound Corliss Engine

size 17 × 28 × 30" direct connected to two Riedler pumps, size 12¼ × 30" capacity, 8,000,000 gallons in 24 hours, speed 100 revolutions. The above pump may be seen in operation. M. H. WEST, Supt., Lincoln Park System, Clark and Center Sts., Chicago. 20-2t